Small-scale Fisheries in Morobe Province:

Landing, Market and Buyer Surveys in Lae

NATIONAL FISHERIES AUTHORITY

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GPA

Tautai

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Acronyms and Terms

ADB	Asian Development Bank
CBM	community-based management
CFMDP	Coastal Fisheries Management & Development Project
ENB	East New Britain Province
EU	European Union
FAD	fish aggregating devices
GIS	geographic information system
GPS	global positioning system
LLG	local-level government
MAS	Manus Province
MBP	Milne Bay Province
MOR	Morobe Province
NFA	National Fisheries Authority
NGO	non-governmental organisation
NIP	New Ireland Province
PNG	Papua New Guinea
NSP	North Solomons Province
UPNG	University of Papua New Guinea

Introduction

Background

This report presents the findings of small-scale fisheries surveys undertaken in Morobe Province between July 2005 and August 2006, as part of the National Fisheries Authority (NFA) Coastal Fisheries Management and Development Project (CFMDP). This report is part of a series focused on fisheries catches, market sales, buyers and socioeconomic surveys designed to characterise small-scale fisheries and to monitor project outcomes in in the PNG provinces of New Ireland, Milne Bay and Morobe.

The characterisation of small-scale fisheries, and their role in these three provinces, form a part of the CFMDP, which is implemented by NFA with loan funding from the Asian Development Bank (ADB) (1925 PNG-SF). The overall aim of the CFMDP is to contribute to the reduction of poverty in rural areas through increasing, or preventing, a further decline in the incomes of coastal communities. This is being done by promoting improved management of resources, and by creating sustainable earning and employment opportunities for coastal communities, improving access to information on the types and scale of fisheries being undertaken, and constructing wharves and jetties.

This report is based on surveys undertaken by enumerators employed by the project, and the collation of existing historical data collected by the Provincial Fisheries Office and by buyers under the conditions of their licences obtained through NFA. The data collected and/or collated by the project include:

1. Surveys of marine products landed by small-scale fishers, usually using canoes or banana boats.
2. Surveys of deepwater and pelagic fishes landed by small-scale fishers and people involved in the European Union (EU) scheme for purchasing longer-range vessels (the so-called "Ducklings") (The Rural Coastal Fisheries Development Project).
3. Surveys of marine products sold at local markets and their relative importance in relation to other items sold, including direct surveys of marine products purchased by buyers.
4. Existing buyer receipts retained by the Provincial Fisheries Office.
5. Purchasing data collected and made available to the project by buyers and NFA.
6. Household surveys examining socioeconomic conditions and the contribution of small-scale fisheries undertaken in several LLGs in each province.
7. Focus group and key informant surveys undertaken in conjunction with household surveys.

These surveys and data collections were undertaken to provide basic information on the relative importance of fisheries to the livelihoods of people in PNG and in this report, specifically in Morobe Province. They were developed to provide information on the types and quantities of marine organisms being collected/caught in the province with a view to assessing the status of the resources and identifying threats and opportunities for the future.

Aims of CFMDP Small-scale Fisheries Surveys

These surveys were designed to gather information from fishers, seafood sellers in markets around Lae, and commercial buyers so that we could use this information to characterise the small-scale fisheries of the area. The purpose of the surveys was to:

- characterise the types, numbers and sizes of fishes, invertebrates and other marine products landed in Lae township by fishers living there or in surrounding areas. This information included some profiling of fishers, including costs and effort, the general location of fishing grounds, and the fishers' home village;
- describe the marine products being sold in Lae Main Market. This information included some profiling of sellers, the source of their products, processing and prices for which they the products are being sold; and
- obtain information on the activities of buyers, including identification and quantities of marine products purchased, and the prices paid.

These three aspects of small-scale fishing were included to cover the supply and marketing of marine products in Lae, with a view to understanding the types and scales of fisheries being undertaken. The study did not include purely commercial fishing, but instead focused on small-scale fishers who provide food for their households, and sell fishes and other marine products to earn cash.

Approach and Methods

Study design

Data on fish landings, market sales and buyer purchases were collected separately for this survey to characterise the capture and use of marine products in the province. All information collected was centred on Lae city, but the marine products described may have been caught as far afield as other provinces (e.g. East Sepik), and brought to Lae by fishers or market sellers, and occasionally buyers.

The three survey/data collections included in this report are:

1. landings of catches brought in to Lae, either for sale at markets or to buyers by small-scale fishers;
2. marine products offered for sale through local markets in Lae; and
3. purchases of marine products by buyers in Lae.

Survey of fishers landings

A survey of marine product landings in Lae was carried out between July 2005 and June 2006 by a team of enumerators trained by the project. Teams of enumerators were placed on a roster system to ensure that fishers were intercepted as they came to two main sites to land their catch. The survey focused on intercepting at least 20 boats per month at each of the two sites.

For each boat intercepted, enumerators interviewed the fishers and identified and measured their catch. Information was collected on 1) landing location, (2) fisher's name, age, and home village, (3) areas fished, (4) fishing methods used, (5) effort expended per fishing trip (including the number of fishers in the boat, hours spent fishing, etc.) and (6) cost of each fishing trip. All marine products were identified to species level, measured (fork length for fishes, carapace and/or tail length or width for lobsters, and shell dimensions for molluscs) and, in the case of crustaceans, their reproductive condition recorded (i.e. sex, whether they were in berry).

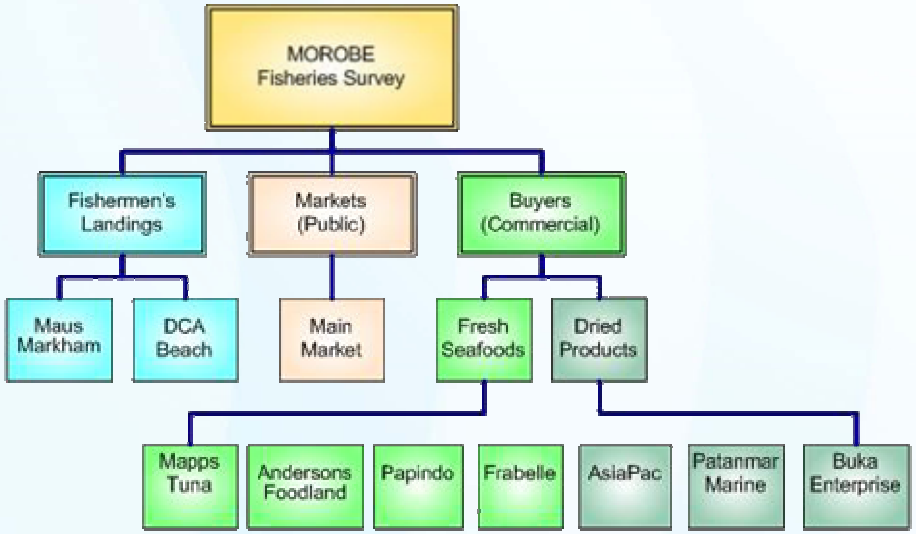
Market survey

Market surveys in Lae focused on the main market and were carried out by the same trained enumerators. The survey targeted three levels of information:

- General information regarding sellers' market tables (including sellers who offered goods for sale on mats placed on the ground) to characterise all products being sold, and to determine the relative importance of marine products (five replicate surveys of the entire market per month);
- More detailed information on those tables offering seafood (20 replicate surveys of the market per month); and
- Detailed surveys of at least 20 tables per month on which all seafood was identified, measured, and details of sex and reproductive conditions recorded where possible. Sellers themselves were also interviewed.

To ensure good coverage of the main types of marine seafood products being offered, enumerators targeted at least 20 tables per month, separately for fresh and smoked fishes, crustaceans and molluscs.

↓ Sampling design for each survey component



Buyer data

Buyer data were obtained by enumerators visiting buyers each month to record details of transactions, including sellers, areas fished, species, length and/or weight, and other characteristics. We were, however, unable to obtain comprehensive monthly records from buyers that would provide a context for the flow-through of marine products. The information in this report therefore focuses on characterising the catches being sold, but does not contain the information necessary to estimate volumes of seafood, or the overall revenue involved.

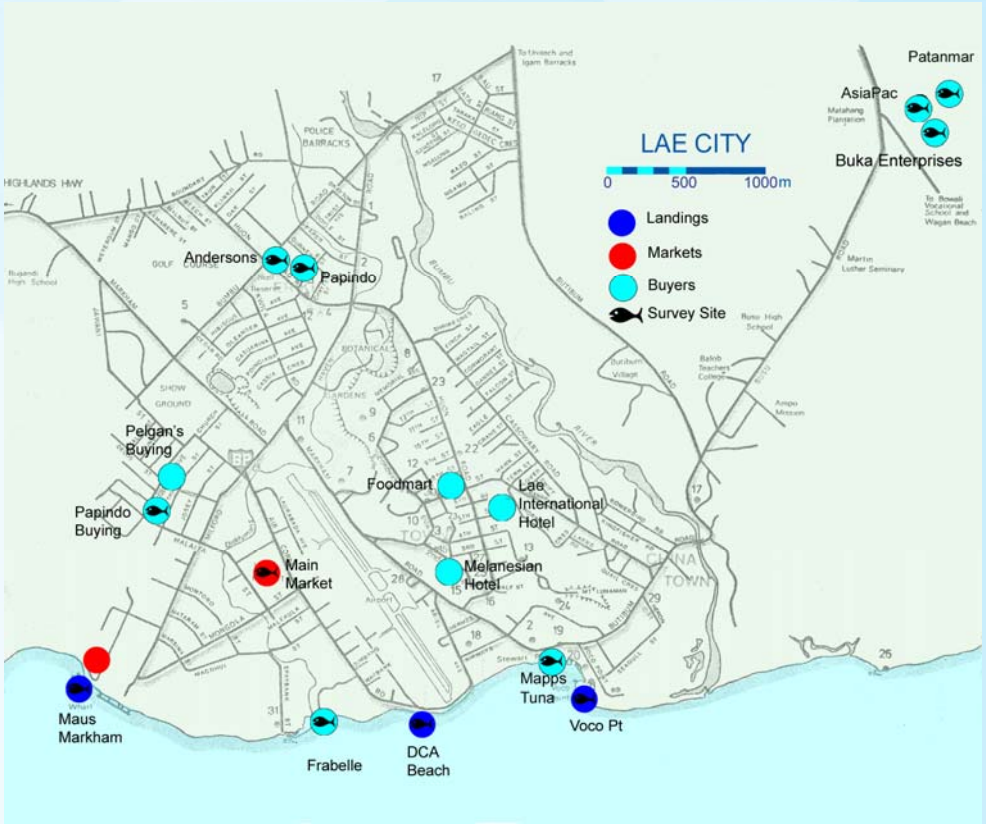
Database

All data from these surveys were collected onto datasheets and entered by trained data entry staff into a purpose-built Microsoft Access database. All data were exported into separate Excel "flat files" for analysis using either Excel or Statistica.

Survey Weaknesses

Landings and market surveys were undertaken by newly-trained local enumerators who had little experience in implementing surveys of this type. As a result, the surveys contain errors that would be eliminated with experience. These results, therefore, should be interpreted with caution, but they are a useful pilot survey of seafood landings and markets in Lae. The main problems encountered were:

1. Identification of fishes, crustaceans and molluscs were sometimes suspect. Enumerators included those with at least some relevant training, but not always including fish taxonomy. The survey team was given species identification cards, and repeated training but members still appear (understandably) to have missed some identifications.
2. Buyer data were discontinuous and incomplete, and did not include estimates of what was coming through the door to each buyer. These limitations in data collection meant that interpretation of the results was difficult, and trends in buying hard to identify. These results should be used with caution, therefore, and cannot be used to estimate total revenues and total tonnages being put through buyer channels.



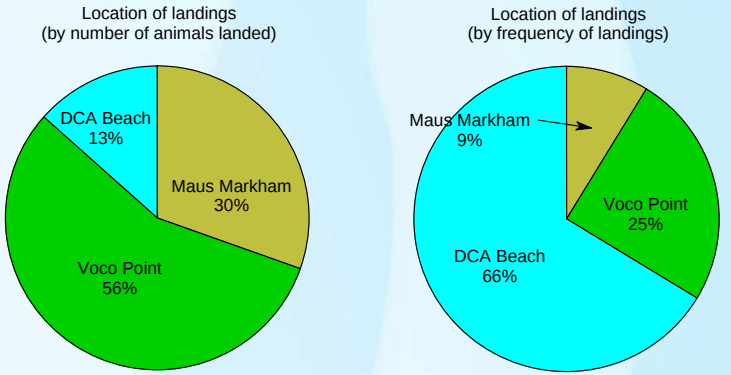
↑ Sampling sites, landings, markets and main buyers in Lae

Fishers' Landings

General information

Where were marine products landed?

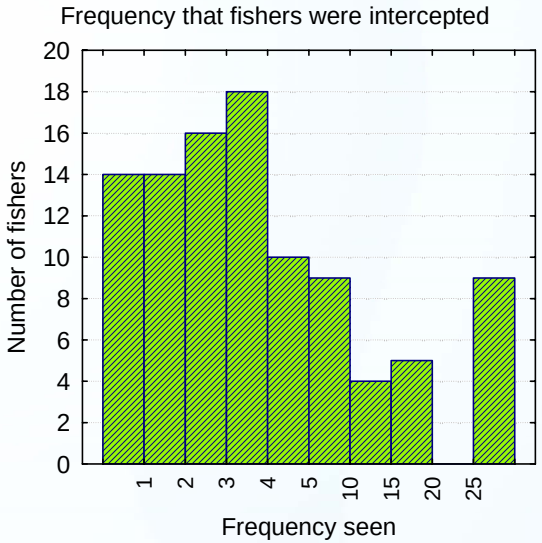
Fishes and other marine products were landed at three main sites around Lae between July 2005 and June 2006. Landings would have occurred elsewhere, particularly where fishers landed near their own or relatives' houses, or near buyers, but these landings were not captured in this survey. Enumerators intercepted the most landings (66%) at DCA Beach, while 25% were intercepted at Voco Point, an area heavily used by small-scale fishers. In terms of the total numbers of marine products landed, Voco Point was most important, being the landing site for 56% of all animals counted. Landings made directly at the door of buyers were considered "buyer samples" and not included in this survey. In those cases, landings made at sites along the Lae waterfront were quickly transported to the buyer where enumerators made their measurements (see buyer survey later in this report).



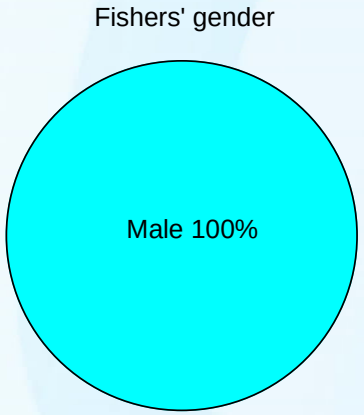
↑ Proportion of landings at different locations around Lae. Percentages are calculated on the actual number of landings at each place, and on the total number of marine animals landed and recorded over the survey (n=775 landings and 4,037 animals).

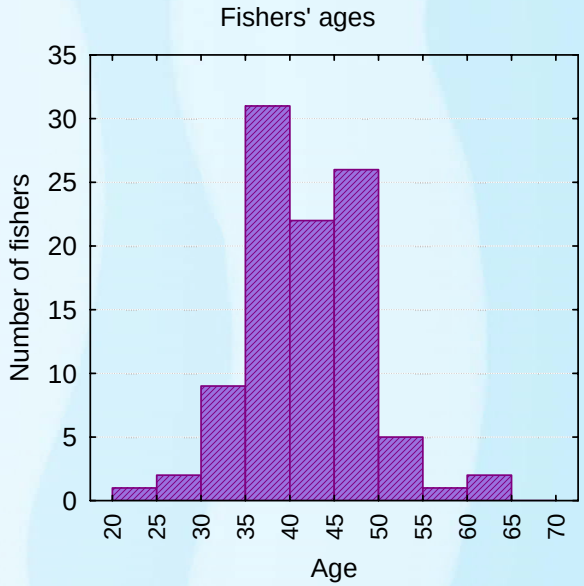
Who are the fishers?

Enumerators carried out 775 interviews with fishers over the period of the survey, reaching 99 individual fishers who landed marine products and were interviewed as part of this survey. The average age of fishers was 43 years, but ranged between 25 and 65 years.
The most common age for fishers was between 35 and 50 years (79% of all fishers), with numbers tapering off at younger and older ages. All fishers interviewed were men.



↓ Proportion of women and men involved in landings of marine products in Lae during the survey (n=99 individual fishers).





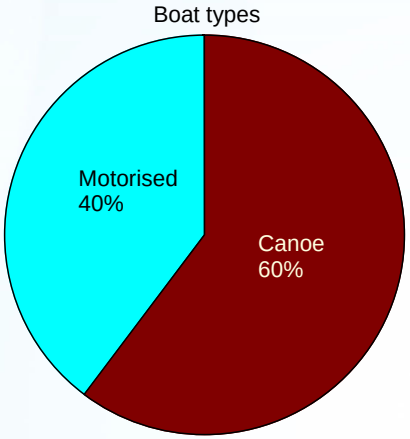
↑ Age distribution of fishers interviewed during the landings survey (n=99 fishers who provided their age).

LANDINGS

What gears and effort are used?

There was a wide range in the frequency with which we interviewed fishers during this survey (see figure on page 9), suggesting that the population of fishers includes dedicated fishers and broader involvement by people who may fish only occasionally. About 14% of all fishers were only interviewed once, and 62% were interviewed four times or less. There were also some very frequent fishers, with about 9% being intercepted 25 times or more over the survey. The maximum number of times a single fisher was interviewed was 92 over the year-long survey.

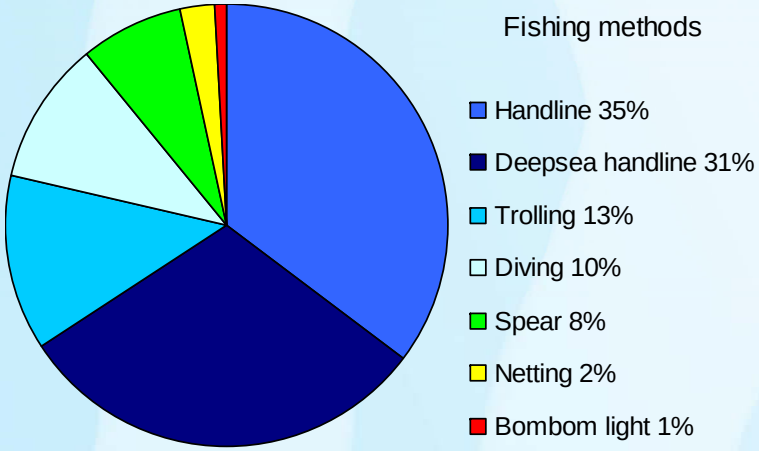
➔ Boat types recorded with landed marine products. Note that 36% of interviews were not accompanied by boat information. Percentages are relative proportions among samples that had boat information (n=775).



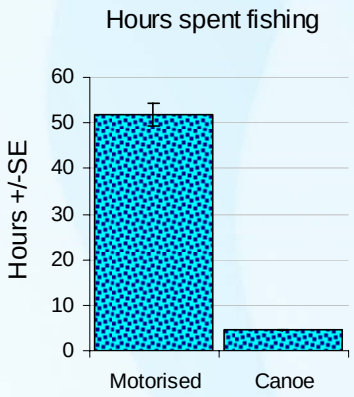
Three main types of boats were recorded for small-scale fishers — canoes (60%) and pump or banana boats (40% of all landings). Note that some canoes are motorised. In terms of effort, fishers using motorised boats spent more hours fishing and used more fuel in fishing and transporting to and from the fishing grounds and markets than did people who used canoes. The average fish catch per hour in canoes was higher than in powered boats, and the number of fishes caught per litre of fuel used was comparable for motorised boats and canoes.

The most common fishing methods used by fishers were various forms of line fishing. Line fishing included deepsea handlining for deepwater snappers, trolling for pelagic species, and handlining for reef fishes. Diving included spearfishing in addition to hand collecting for crustaceans. Nets and traditional lights (burning leaves called "bombom") were only minor forms of fishing.

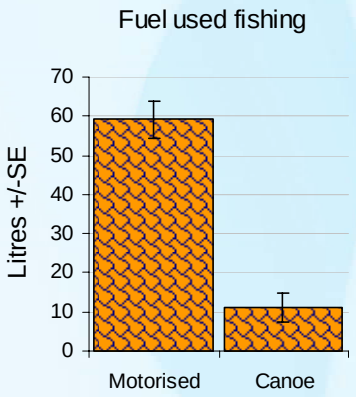
➔ Fishing methods recorded with landed marine products. Note that a mix of fishing methods was usually reported with each catch (n=1,252 methods reported over 775 landings).



(a)



(b)



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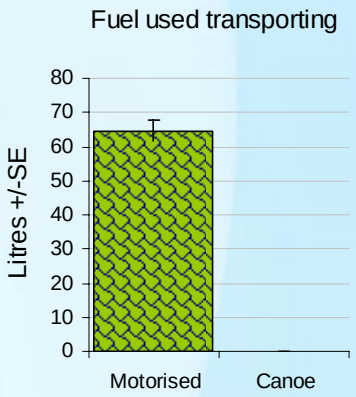
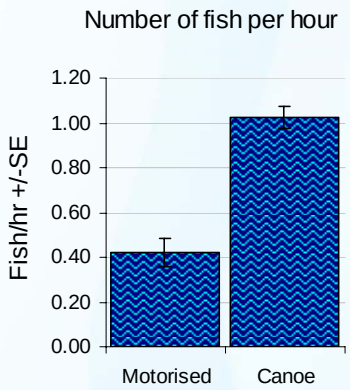


↓↗ Comparison of fishing effort and returns for each boat type used by fishers landing their catches in Lae. The top three graphs (a to c) show relative use of resources for fishing, and the bottom graphs (d to g) the relative returns in numbers of fishes or proxy weight for each hour and litre spent fishing. Graphs d and e do not take into account the size and weight of fishes caught, and report only raw numbers. In graphs f and g we calculated a proxy for the weight of fishes caught by cubing the fork length and multiplying by 2.5%/1000. This provides a rough approximation for weight caught as "proxy weight" in kilograms — these data should be interpreted with caution as they are estimated from a standard calculation and not the specific length-weight relationships for each species. Note also that some canoes do have small motors.

A weight measure (from the length data collected during the survey) was calculated in order to re-examine the relationship between boats, time and fuel used and returns. Proxy weight here is calculated as the cubed fork length multiplied by 2.5% to produce an weight estimate in grams. In terms of weight of fishes caught per hour and per litre of fuel, however, banana boats were more efficient. These results suggest that canoes are targeting smaller fishes and obtaining larger numbers of them. Some banana boats target larger and higher value fish (e.g. deepwater snappers and tunas), perhaps because these boats can travel farther.

(d)



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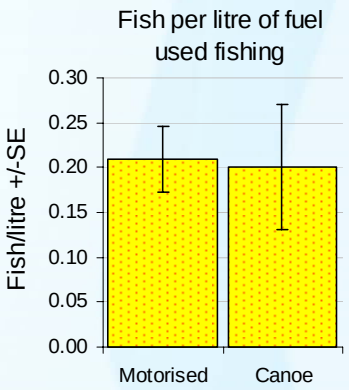

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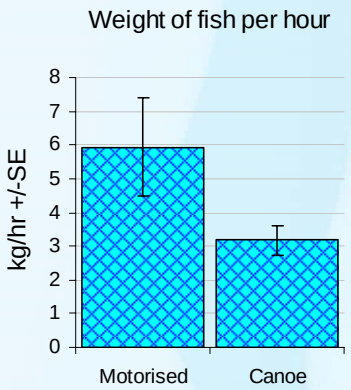

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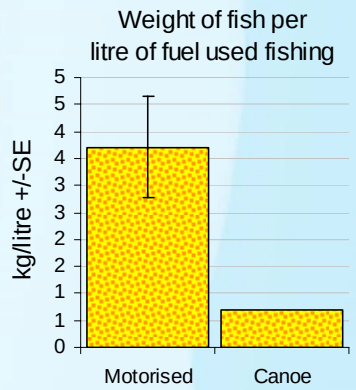


LANDINGS

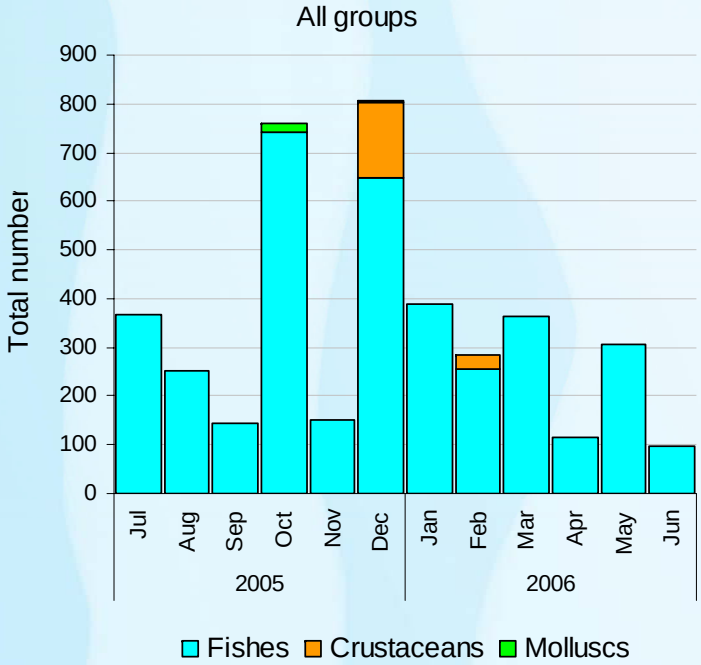
The catches: All Groups

A total of 4,307 marine products were landed during the one-year survey from July 2005 to June 2006. This number included 3,830 fishes, 183 crustaceans, and 24 molluscs. The total number of unique species recorded over the survey was 132. This consisted of 124 species of fishes, 6 species of crustaceans, and 1 species of mollusc.

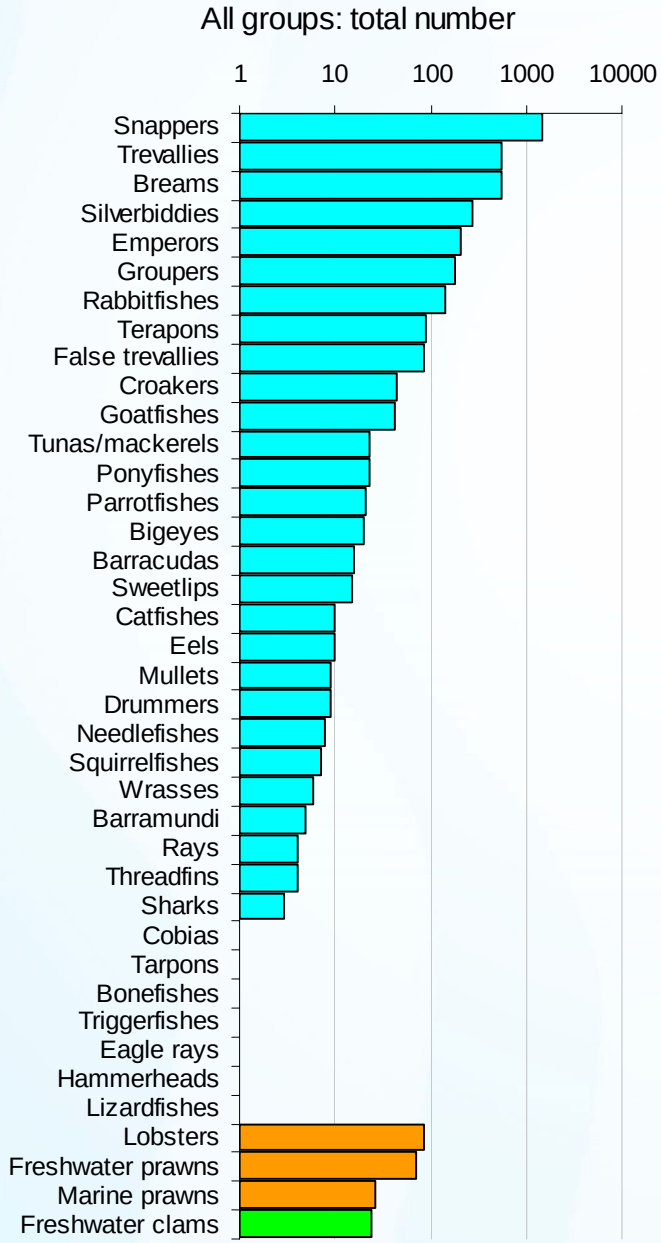
Group	Number
Fishes	3,830
Crustaceans	183
Molluscs	24
Total	4,037

Landings were greatest during the period October and December 2005, and lowest in September 2005, and April and June 2006. These results are at least partly related to the sampling effort expended in the form of the number of boats met during different months of the survey. That is, the team were unable to meet the same number of boats each month so, to some extent, months with low numbers are correlated with months with smaller numbers of recorded landings. It is not clear whether the lower sampling was related to smaller numbers of fishers working at those times, but the results suggest that a greater sampling effort may be required to better characterise these fisheries. These data give a preliminary characterisation of the types of organisms landed, and the effort and information on the fishers, but are insufficient for calculating total catches and effort.

Most marine products landed were fin fish, with only very small numbers of molluscs. No sea cucumbers or other organisms (such as turtles) were landed during the survey. The most common groups of fishes landed were snappers (including deepwater and reef species), trevallies, scads and rainbow runners, whiptail breams and silverbiddies. The crustaceans landed included lobsters, banana and tiger prawns, and freshwater prawns. All landed molluscs were freshwater clams.



← Totals of marine products landed per month (n=4,307).



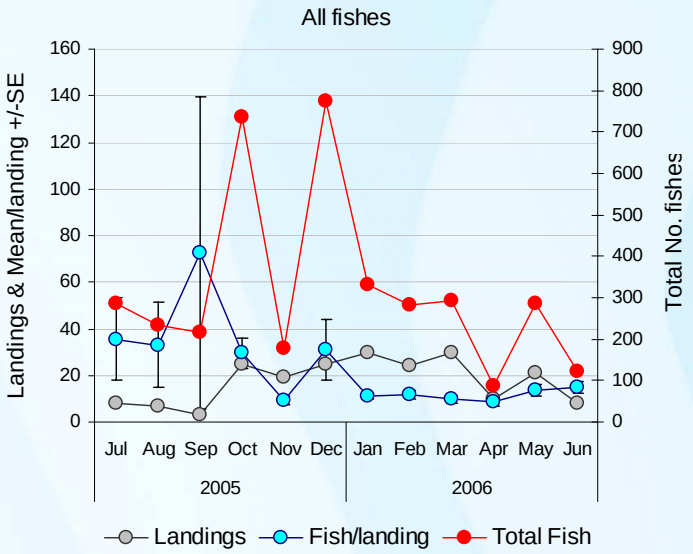
↗ Total landed catch of marine products broken down into families for each group. Note that the scale is logarithmic.

Fishes

A total of 3,830 finfish from 35 families and over 124 species were recorded and measured during the survey of fish landings in Lae. The large number of species involved in the fishery is typical of tropical fisheries, which in this case includes reef, oceanic and estuarine areas.

The average number of fishes landed in a day by individual boats was about 18, and ranged between 1 and 330. The average number of fishes landed declined over the period of the survey from high values (and more variable ones) in the July-September 2005 period. The total number of fishes landed was highest in October 2005, and lowest in April 2006. In contrast, the number of fishing boats intercepted was low in the period July-September 2005 (between 3 and 8 landings), but increased to a rate of 23 boats/month after that time. In the final month of sampling, the number of boats intercepted dropped to 8. The average number of landings intercepted was 18/month over the whole survey, and reached a maximum of 30 in January and March 2006, interestingly at a time when total catches were only average. The average number of fishes landed per month was 319 and ranged between 88 and 776.

These results are related to sampling effort and the number of available boats for sampling, and probably do not reflect overall patterns in catches or landings. These results suggest that a greater sampling effort may be required to characterise these fisheries, particularly because there is a mix of fishers who appear only once or twice in our samples and a significant number who are dedicated "fishermen".

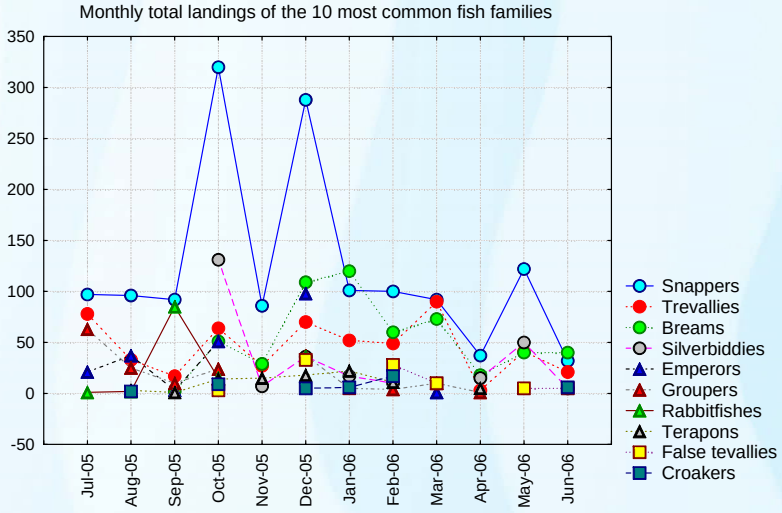


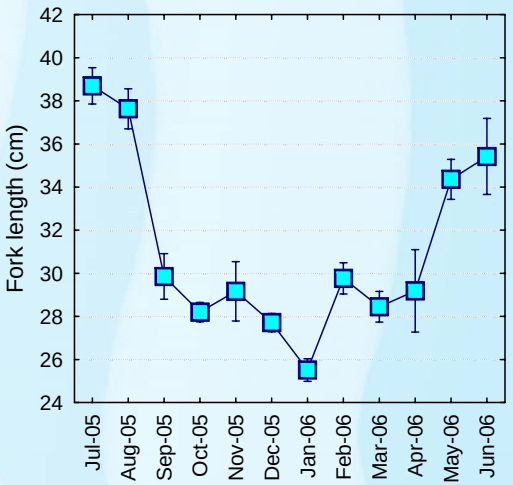
↑ Average number of fishes per landing, number of landings per month of the survey and total number of animals landed for all fishes (n=212 landings involving fishes).

↘ Average size of fishes landed by month during the survey. Data are means +/-SE and ↓ Monthly totals for the 10 most common families.

The overall mean size of fishes was around 30 cm (fork length), with the median at 27 cm (that is, half of the fish were 27 cm or less). The minimum size of fishes measured was 10 cm (including silverbiddies and breams) and the maximum was 174 cm (an eel). The families contributing the largest fishes to those landed were hammerheads, cobias and eels (see next page).

The average size of fishes landed was greatest in July-August 2005 and May-June 2006 (34-39 cm) and dropped to around 25 cm in January 2006. This result is likely to be related to changes in target species over time. January 2006 was the month with the highest catches of breams, which tend to be small species.

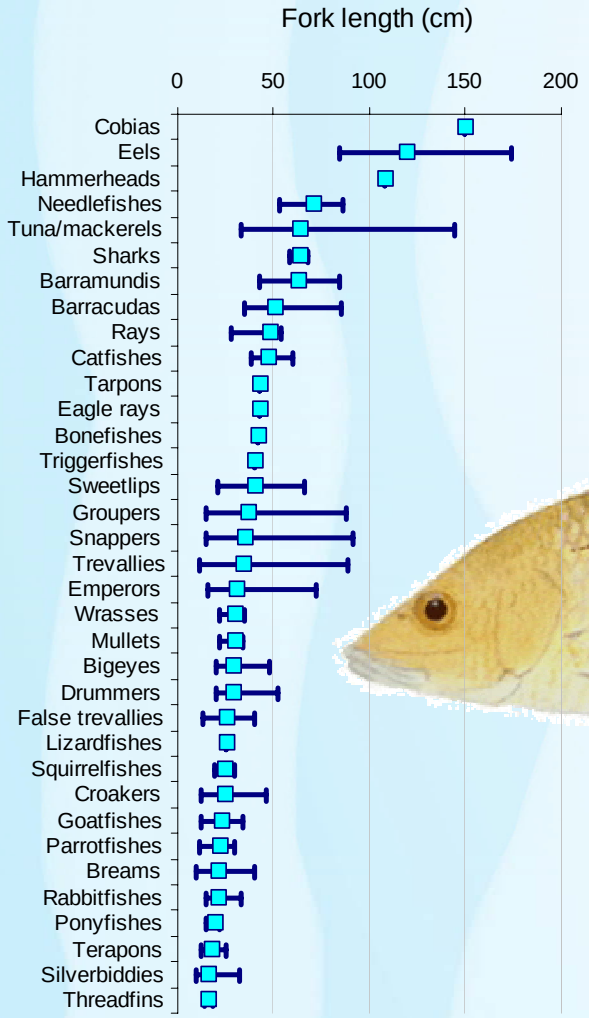




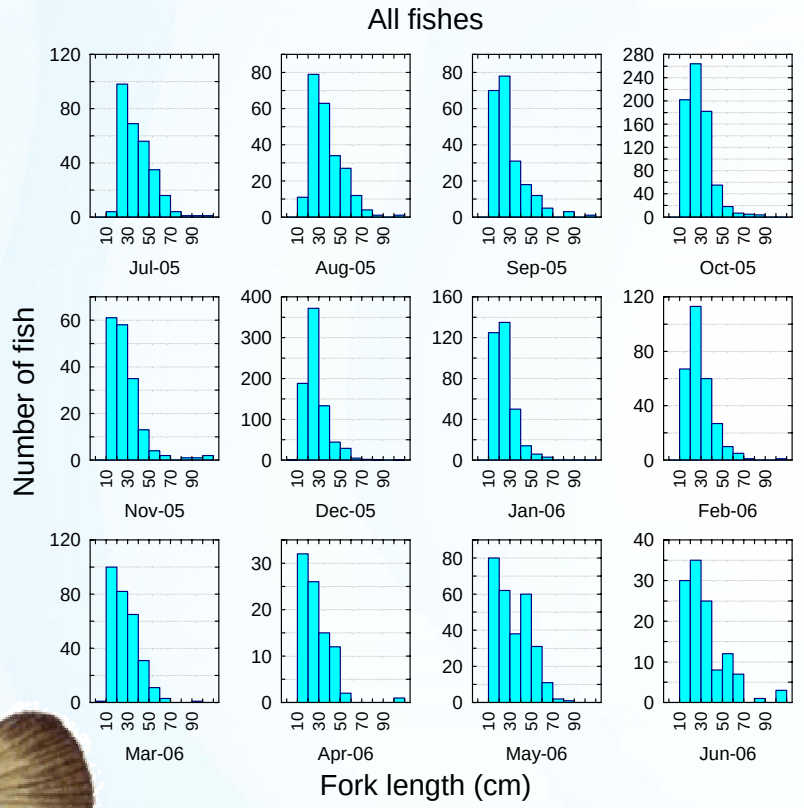
LANDINGS

The mean and maximum sizes of fishes landed (shown below) showed broad size ranges for some families, and very narrow ranges for others. The maximum sizes found in many of the families tended to be significantly smaller than the maximum sizes known. A more complete analysis of sizes of fishes caught in relation to minimum size for reproduction and maximum size attained, is recommended for these fisheries. There may be signs of overfishing for some groups.

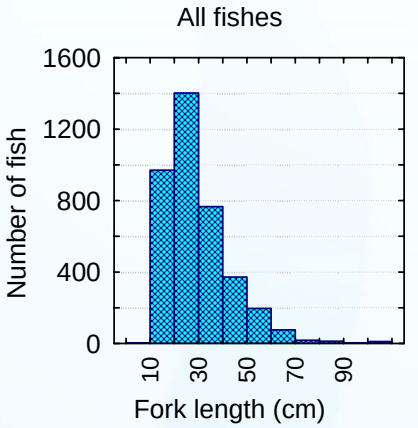
Overall, despite the dominance of the catches by number, of snappers and trevallies that include many larger species, the overall size distribution of fishes was low, with few individuals of over 50 cm fork length (<8%). There was also no obvious change in size frequency of fishes caught over the year.



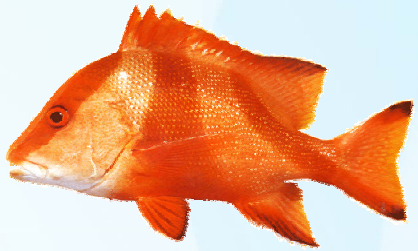
← Summary of size ranges and average sizes recorded across all landings in each family. dark blue bars show range and lighter squares the overall averages, n= the total number of fishes sampled in each family.



Size distribution of all finfish landed during the survey. ↑ The size distribution of fishes sampled each month, and → sizes overall. For this and all following size distribution graphs, the x-axis shows size groupings and the y-axis the number landed in a grouping.

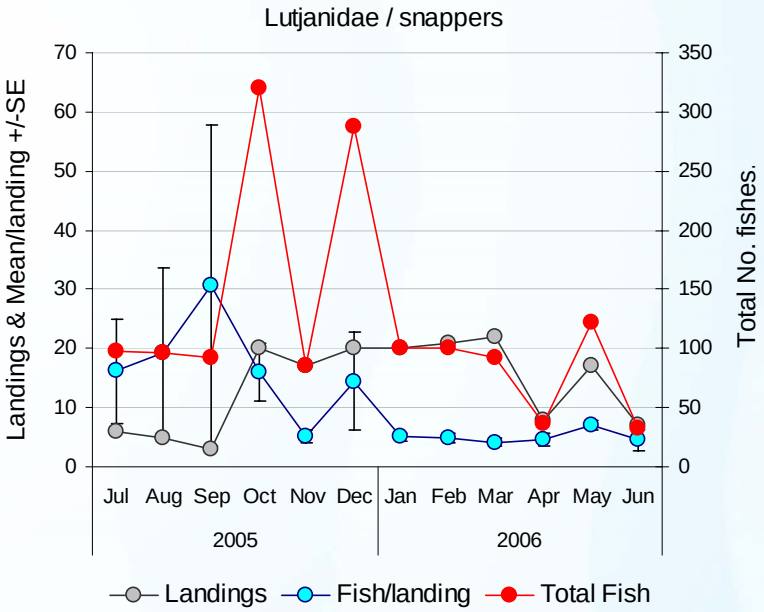


FISHES > Lutjanidae / Snappers

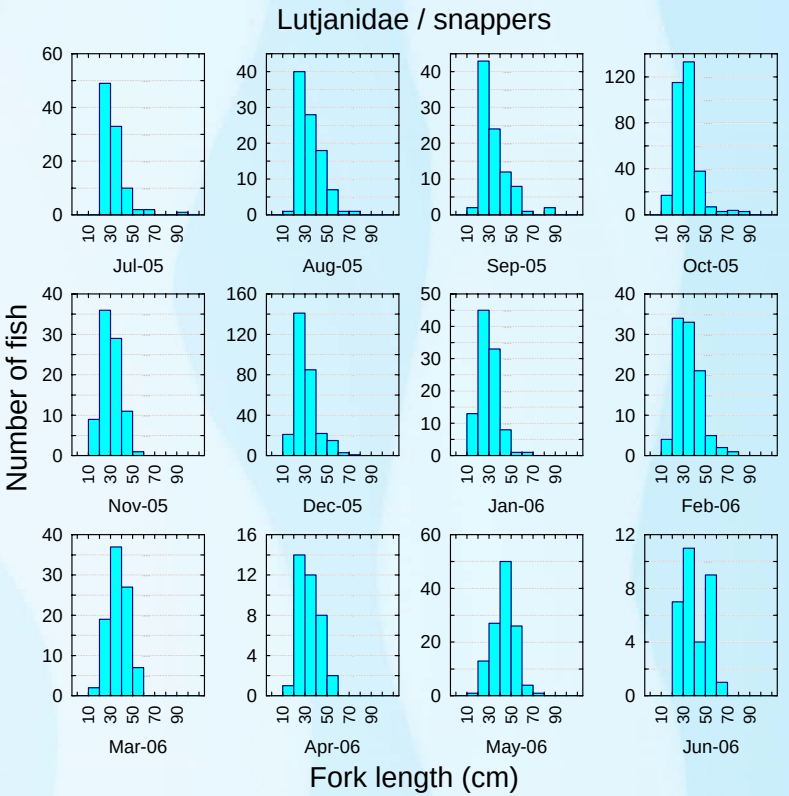


Snappers were the most common fish group recorded in the fish landings during the survey, accounting for 38% of all fishes landed, and 36% of all marine animals landed. This included snappers of 6 genera, at least 23 identified species, and 1,463 animals recorded and measured during the survey. The average number of snappers landed per boat per day was 8.8 fish, and ranged up to 166 fish per landed catch. Over the survey period, the number of landings per month that included snappers ranged between 3 and 22, with a total of 166 landings including snappers. The maximum number of snappers landed in a month was during December 2005.

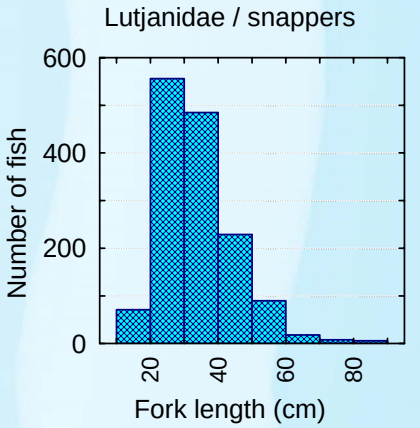
The average size of all snappers landed was 34.5 cm and varied between 8 cm and 104 cm fork length. More than 70% of all snappers landed were between 20 cm and 40 cm long. The sizes of snappers caught did not vary significantly with month during the survey.



← Average number of snappers per landing, number of landings per month of the survey, and total number of snappers landed over the survey (n=166 landings).



➔ Size distribution of snappers landed during the survey, and ↗ broken down by sampling month (n=1,463 fish).

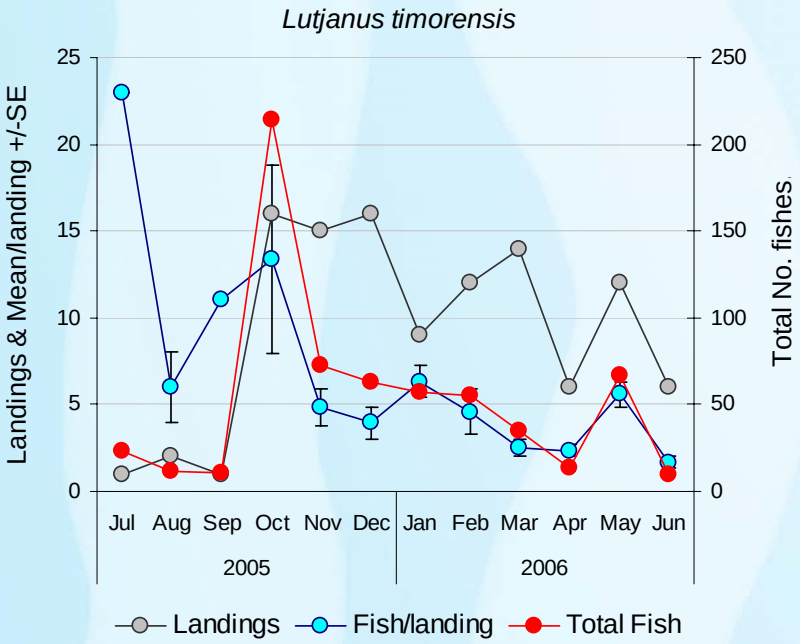


LANDINGS

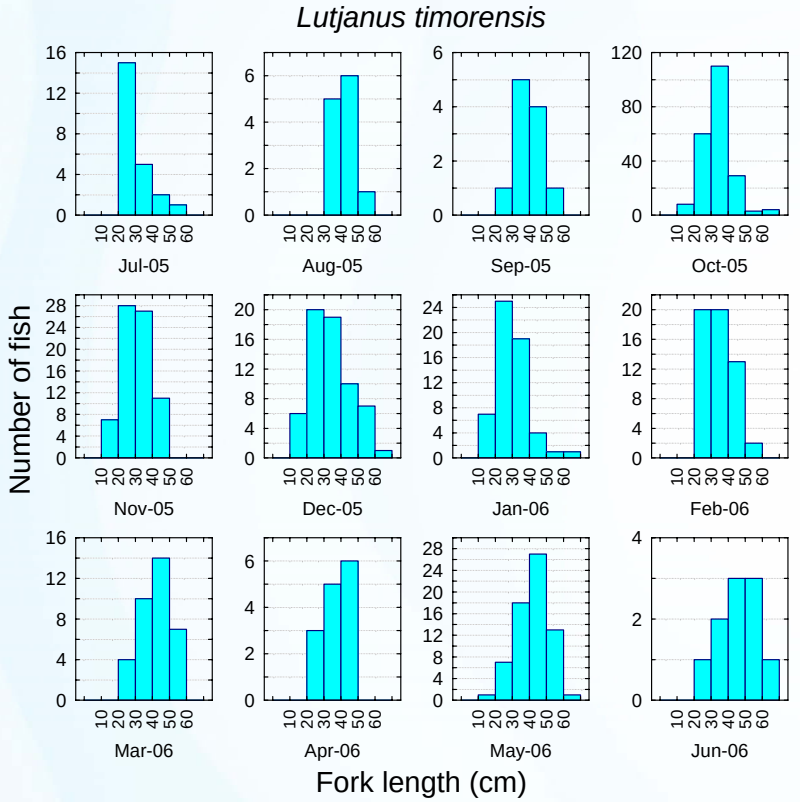
FISHES > Lutjanidae / Snappers > *Lutjanus timorensis* / Timor sea perch

Timor sea perches were the most abundant species of snappers recorded during the landings survey. A total of 634 of these snappers were recorded during the survey. Most of these were landed in October 2005. The average number landed per month overall was around 53 fish, with an average of 5.8 fish per landing overall. The average number of fish of this species per landing changed during the survey. Although the variance was high, there were more Timor sea perches per landing in 2005 than in 2006, but larger numbers of landings after October 2005. The total number of fish landed in that month was 214.

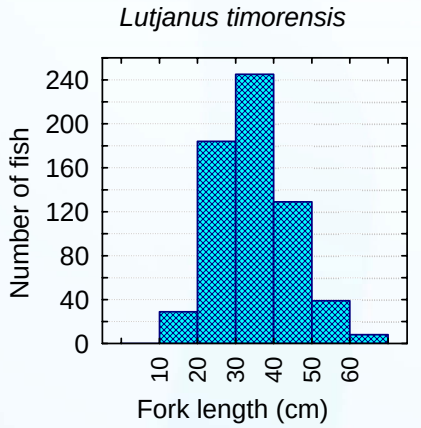
The mean size of Timor sea perch landed was 35.5 cm, and ranged between 15 and 78 cm during the survey. The maximum recorded size for this species is 50 cm, and Timor seapercehs are often confused with *Lutjanus malabaricus*, the Malabar snapper which reaches 100 cm total length. The most common size of Timor sea perches was between 30-40 cm fork length.



← Average number of Timor sea perch per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=110 landings).



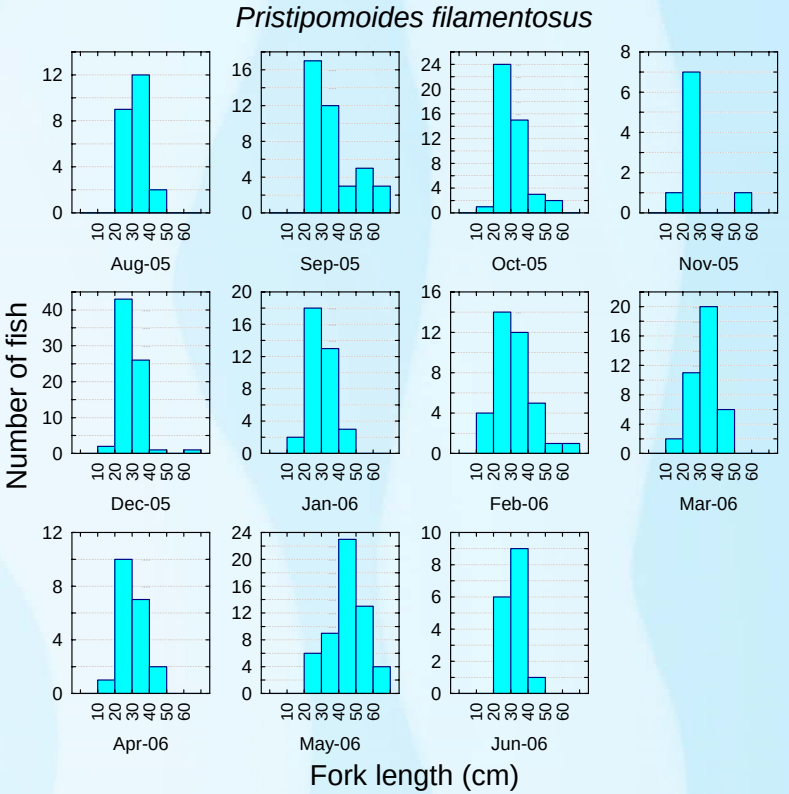
➔ Size distribution of Timor sea perches landed during the survey, and ↑ broken down by sampling month (n=634 fish).



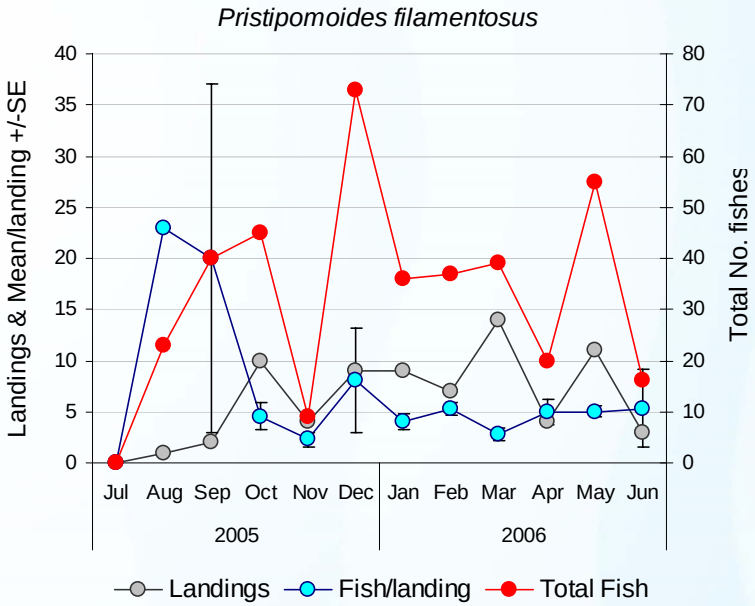
FISHES > Lutjanidae / Snappers > *Pristipomoides filamentosus* / Rosy jobfish

Overall, 393 rosy jobfish were recorded during the survey, with an average of 5.3 fish per landed catch, and a range of between 1 and 49 fish per boat. The most landings that included this species were made in March 2006, while the most fish landed in a month was 73 in December 2005.

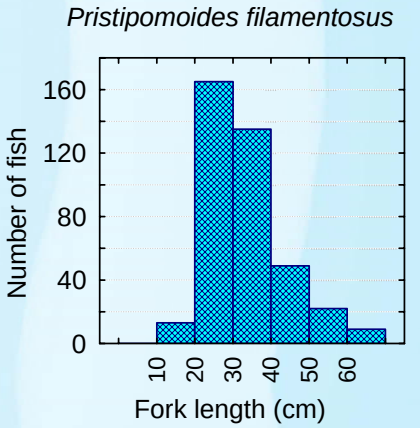
The average recorded size of rosy jobfish was 34 cm, but ranged between 15 cm and 84 cm fork length (based on 393 measured fish). The largest sizes recorded for this species was 100 cm total length, and the size for first reproduction between 34 cm and 50 cm total length. The largest fish landed were in September 2005. Using the minimum size for reproduction, about 20% of the fish landed were large enough to reproduce.



➔ Size distribution of rosy jobfish landed during the survey, and ➔ broken down by sampling month (n=393).



➔ Average number of rosy jobfish per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=393 fish, 74 landings).

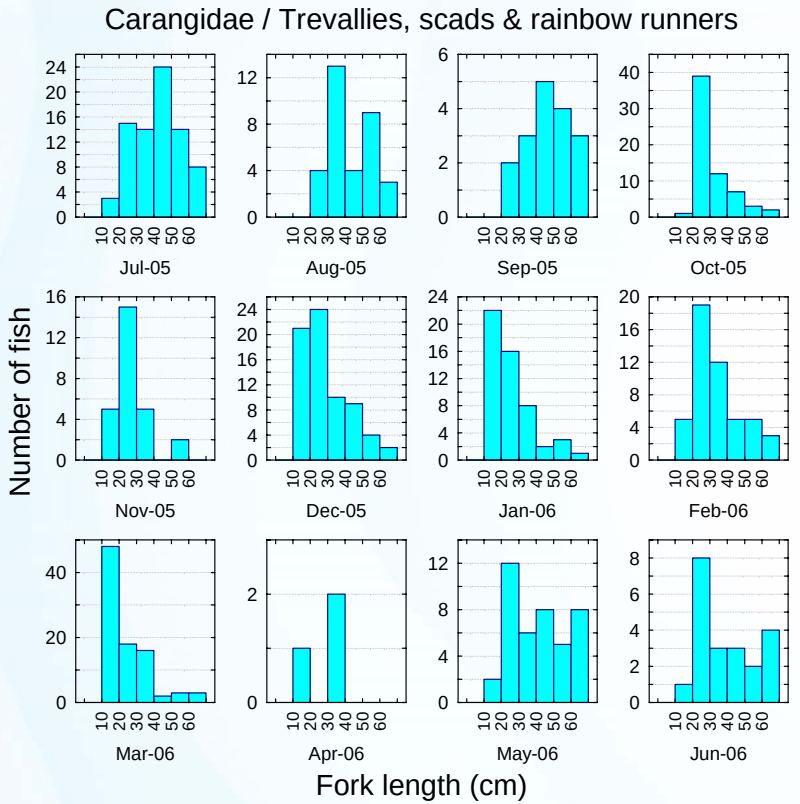


LANDINGS

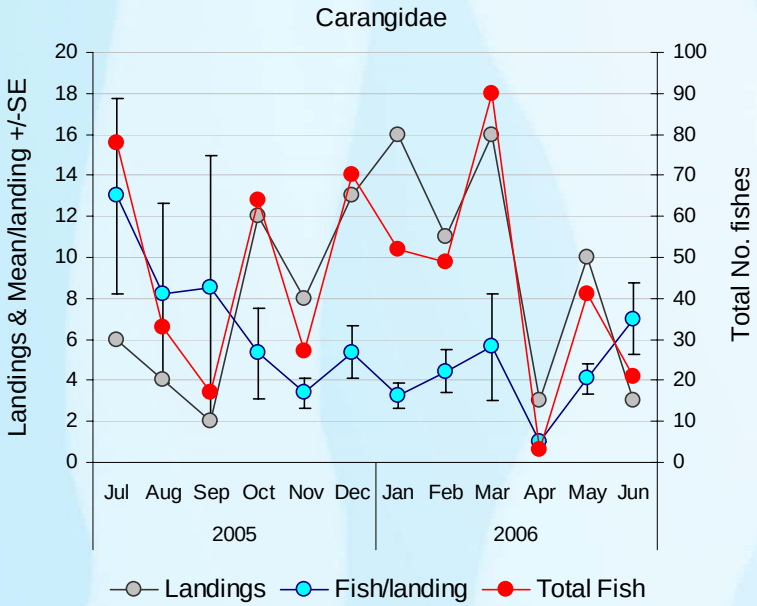
FISHES > Carangidae / Trevallies, scads and rainbow runners

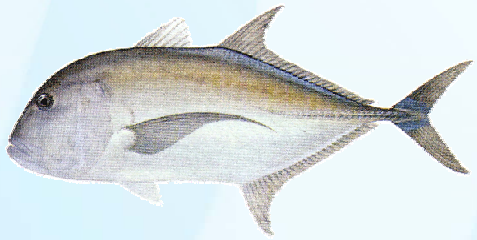
A total of 545 fish (14% of all landed catch) were recorded in the carangid family during the survey. The carangids landed included trevallies, scads, queenfish, horse mackerels and rainbow runners in 10 genera and 20 species. Overall, 104 landings that included these fishes were recorded during the survey, with an average of around 5.2 fish landed per boat per day and 45 per month. The maximum number recorded in any one landing was 43 fish. Large numbers of carangids were landed during July, October and December 2005 and march 2006.

The average size of carangids was 34 cm fork length, and ranged between 11 cm and 89 cm. Most fish caught were between 20 and 30 cm in length, but there were significant numbers of fish over 50 cm.

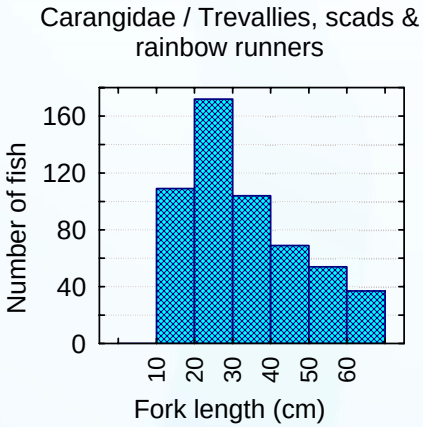


🡻 Average number of carangids per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=545 fish and 33 landings).





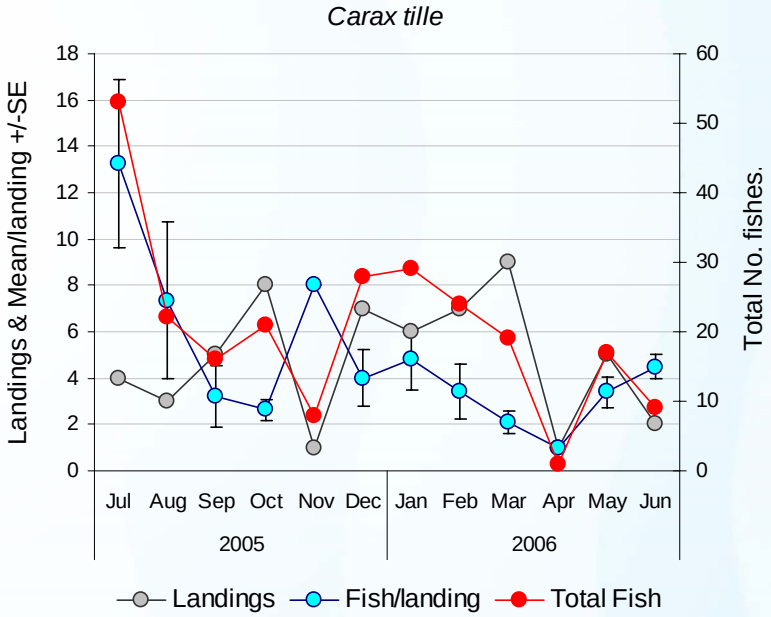
➔ Size distribution of carangids landed during the survey, and 🡹 broken down by sampling month (n=545).



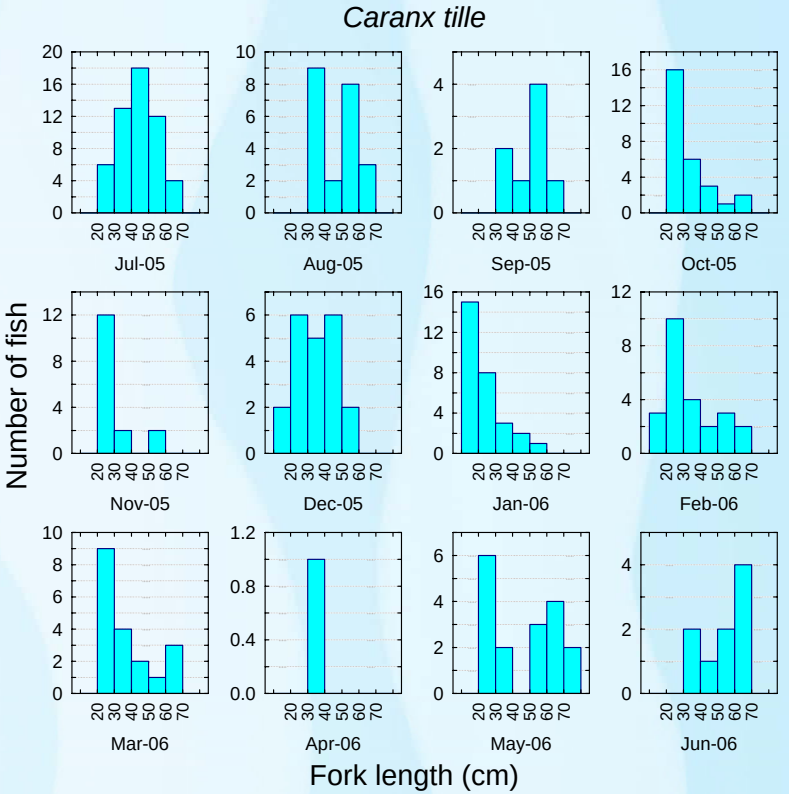
FISHES > Carangidae > *Caranx tille* / Tille trevally

Tille trevallies were the most common single species in the carangid family, recorded in a total of 58 landings. The total number of these fish was 247 and the catch of this species was highly variable. The greatest catch of tille trevallies was landed in July 2005. The average number of fish per landing was 4.3 overall, but ranged up to 20 fish in a single boat load.

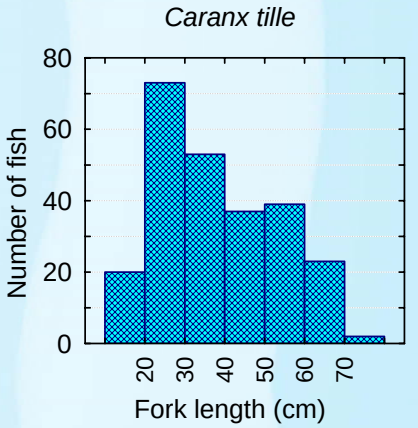
The average length of tille trevallies 38.6 cm fork length, and ranged between 11 cm and 89 cm. Most fish were between 20 cm and 30 cm, with about 26% being over 50 cm long. The maximum recorded length of this species is 80 cm total length.



← Average number of tille trevallies per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=247 fish, 58 landings).



➔ Size distribution of tille trevallies landed during the survey, and ↗ broken down by sampling month (n=247).



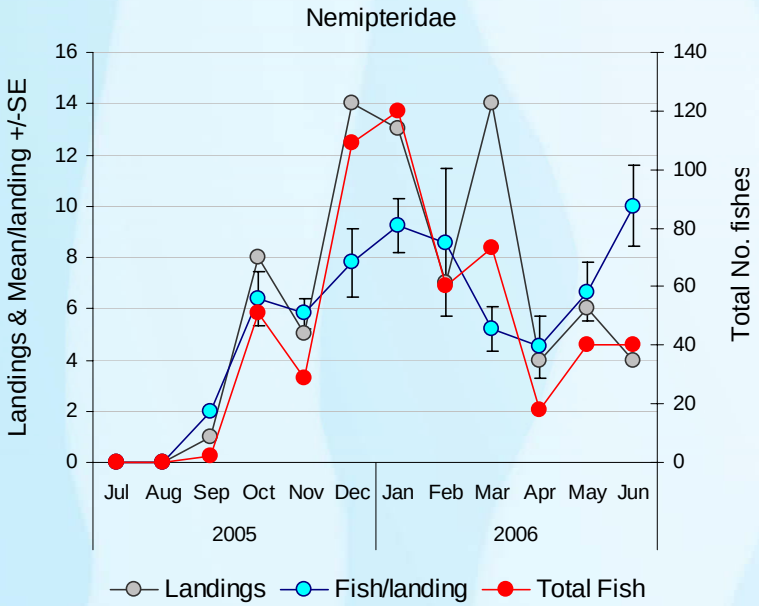
LANDINGS

FISHES > Nemipteridae / Threadfin breams

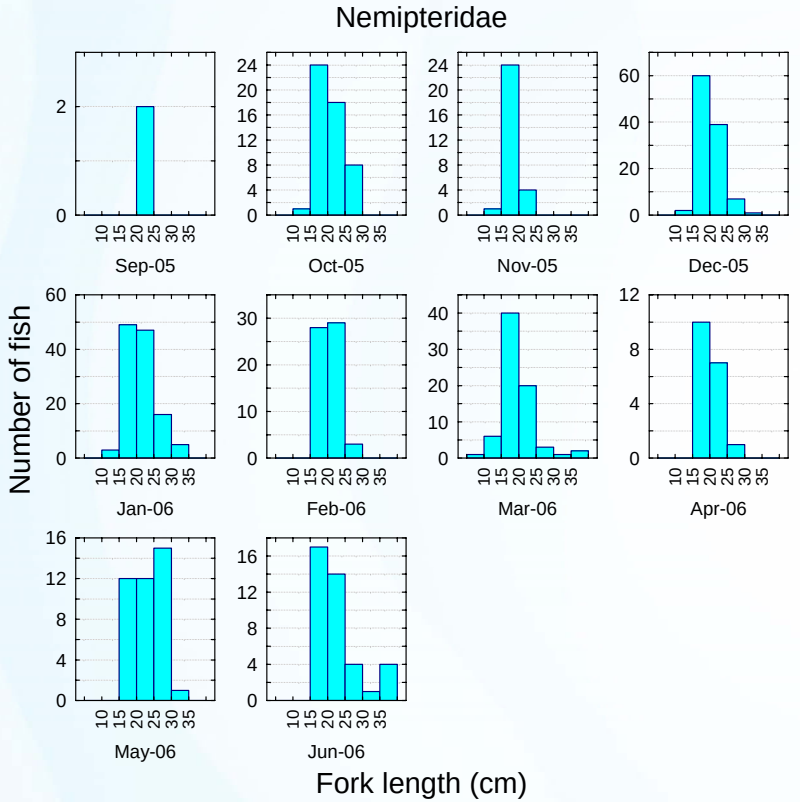
Threadfin breams were the third most abundant family of fish recorded in landings, accounting for 14% of all landings. A total of 542 fish were recorded, including the butterfly whiptail and probably several other species.

Threadfin breams were abundant in samples from December 2005 to the end of the survey, with smaller landings between July and November 2005. The average number of fish per catch was 7 and ranged between 1 and 14 fish per boat per day.

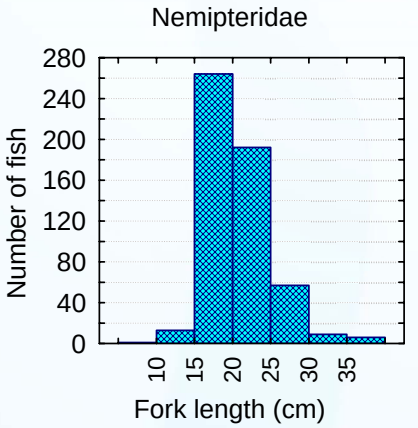
The average length of breams was 21 cm, ranging between 10 cm and 40 cm. Most were between 15 cm and 20 cm long.



← Average number of threadfin breams per landing, number of landings per month and total number of individuals landed over the survey (n=542 fish, 76 landings).



↘ Size distribution of breams landed during the survey, and ↑ broken down by sampling month (n=542).

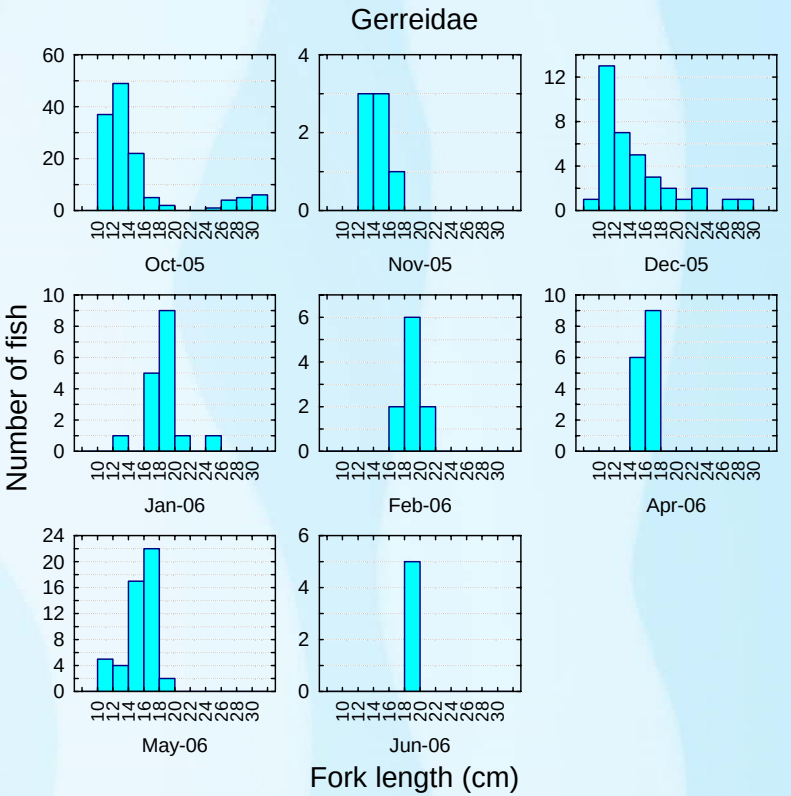


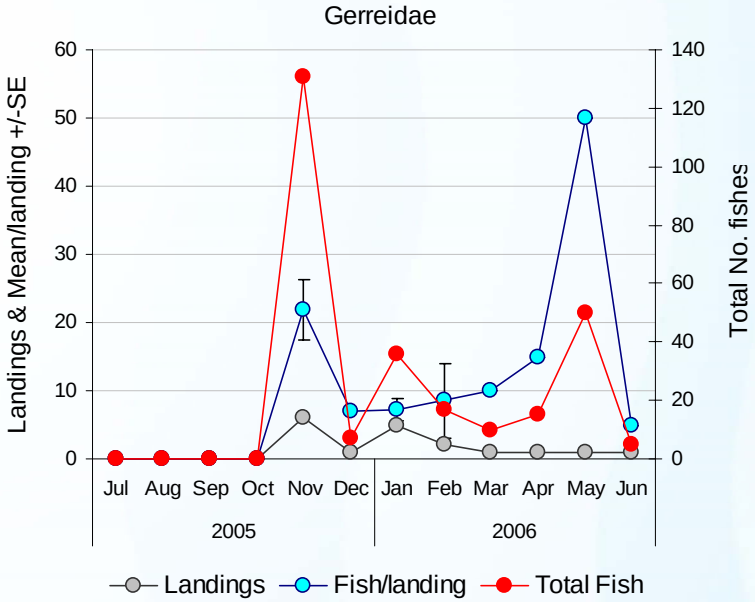
FISHES > Gerreidae / Silverbiddies

Silverbiddies accounted for 7% of the total recorded landings in Lae during the survey. A total of 271 fishes in this family were recorded, including *Gerres subfasciatus*, the common silverbelly.

The greatest number of silverbiddies landed was during November 2005, with moderate numbers recorded in January and May 2006. The average number of silverbiddies per landing was around 15 fish, with a maximum of 50 in a single boat.

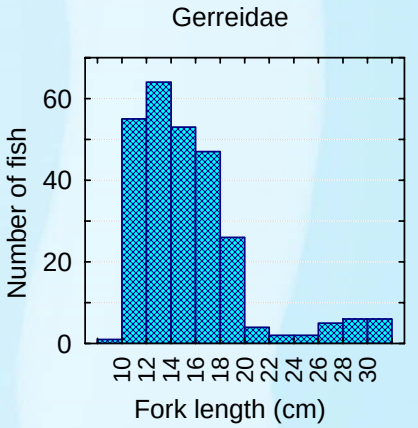
Fishes in this family averaged 16 cm fork length, and varied between 10 cm and 32 cm. Most fish were between 10 cm and 20 cm long. The broadest size ranges in these fish was recorded in December 2005. The common silverbelly reaches a maximum size of 20 cm total length. It is likely that several species belonging to this family were recorded during the survey.





← Average number of silverbiddies per landing, number of landings per month and total number of individuals landed over the survey (n=271 fish, 18 landings).

➔ Size distribution of silverbiddies landed during the survey, and ↑ broken down by sampling month (n=271).

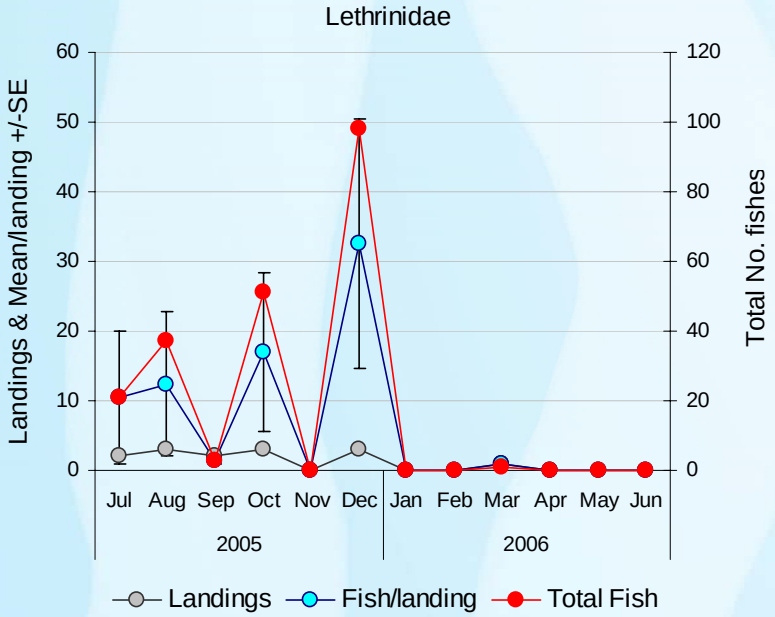


LANDINGS

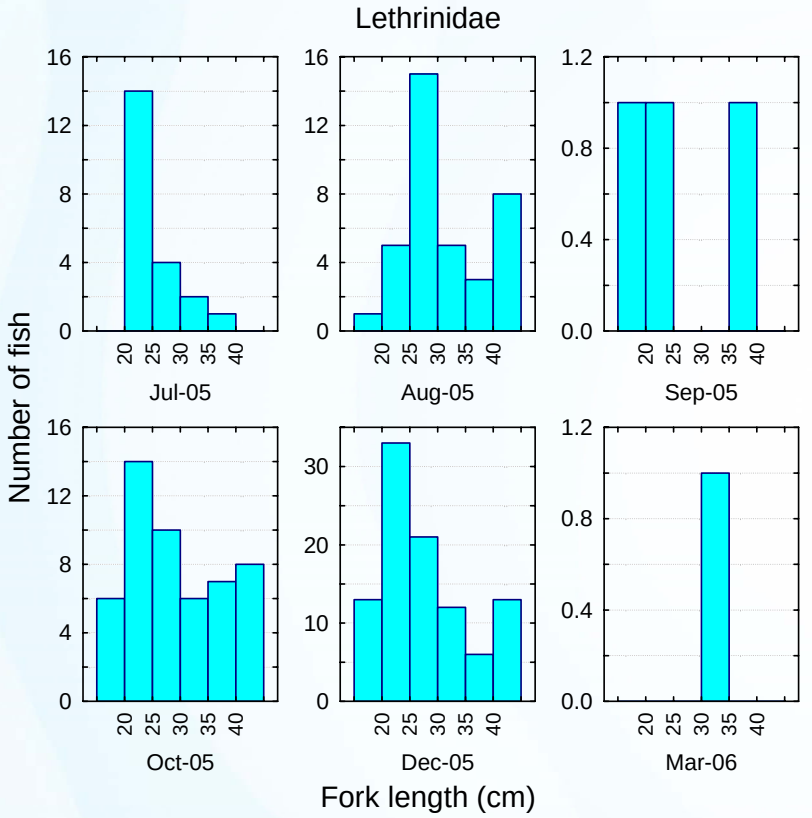
FISHES > Lethrinidae / Emperors

A total of 211 emperors were recorded during the survey over a total of 14 landings and accounting for 5% of all landings. The largest numbers of emperors were landed during December 2005, with few recorded after that time. The average number of these fishes was 15 per boat, ranging up to 63.

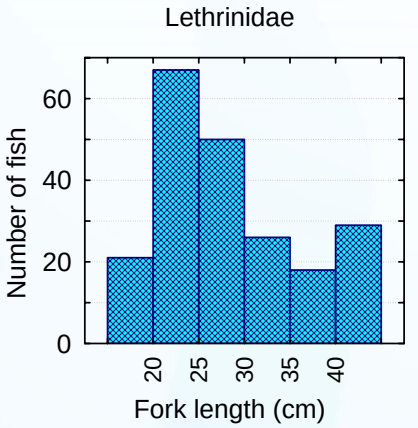
The average size of fishes in this family landed was 30 cm fork length, and varied between 16 cm and 72 cm. Most fishes were between 20 cm and 25 cm long, although there were significant numbers (14%) over 40 cm fork length.



← Average number of emperors per landing, number of landings per month and total number of individuals landed over the survey (n=211 fish, 14 landings).



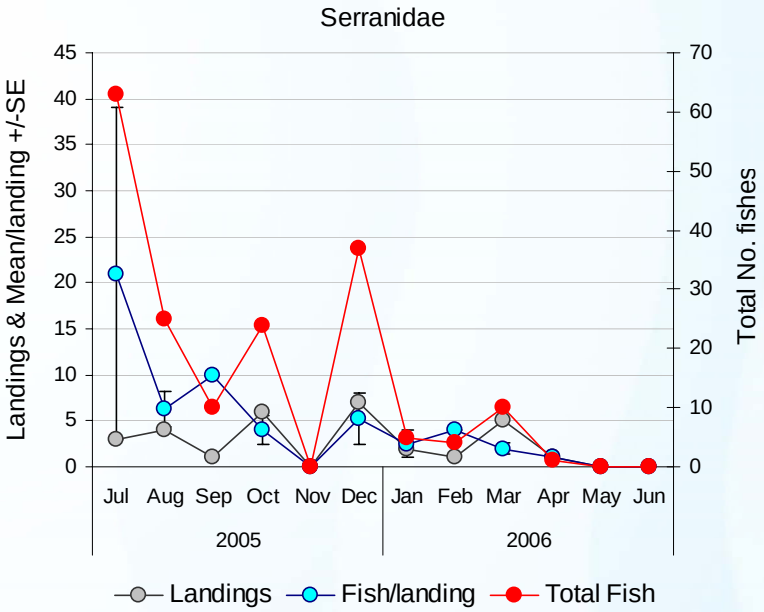
➔ Size distribution of emperors landed during the survey, and ↑ broken down by sampling month (n=211).



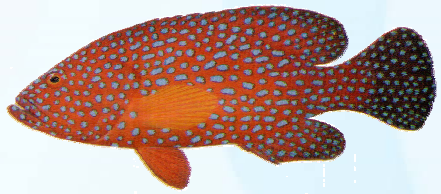
FISHES > Serranidae / Groupers

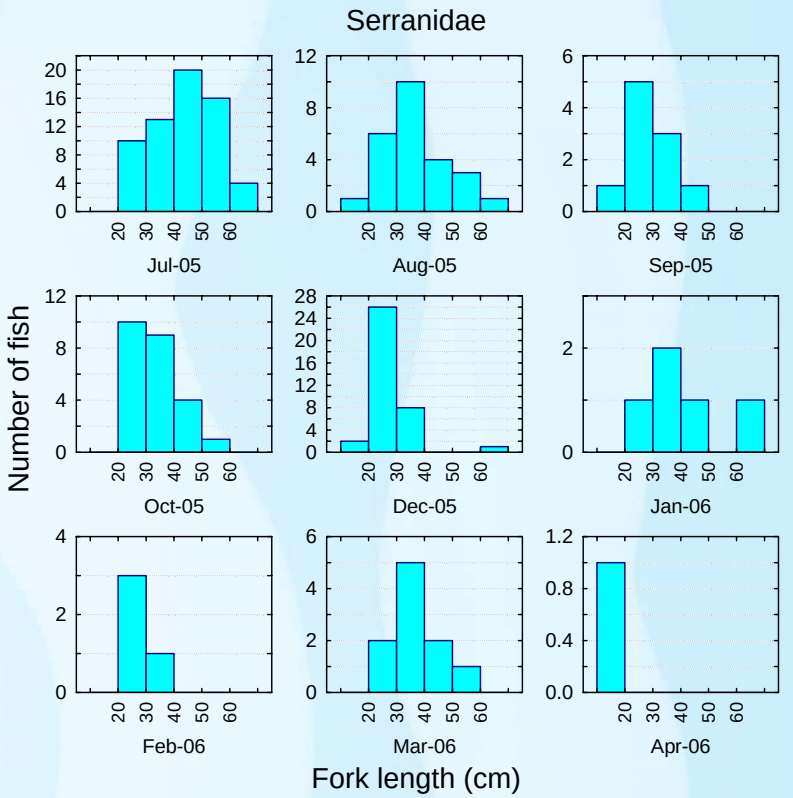
Groupers were found in 30 of the recorded landings during the survey and accounted for 4% of all marine products landed. Recorded members of this family included 5 genera and 17 species, including cods, groupers and coral trout. A total of 179 fishes were recorded, with an average of 6 fishes per catch and a maximum of 57 fishes landed in a single boat load. The total number of fishes landed per month varied during the survey, with the greatest numbers recorded in July and December 2005.

The average length of groupers landed was 36.8 cm, and ranged between 15 cm and 88 cm. Most of the fishes landed were between 20 cm and 30 cm long, although there were 7 fishes recorded at over 60 cm long.

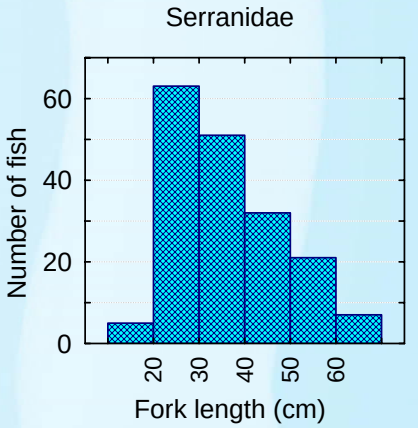


← Average number of groupers per landing, number of landings per month and total number of individuals landed over the survey (n=179 fishes, 19 landings).





↗ Size distribution of groupers landed during the survey, and ➔ broken down by sampling month (n=179).



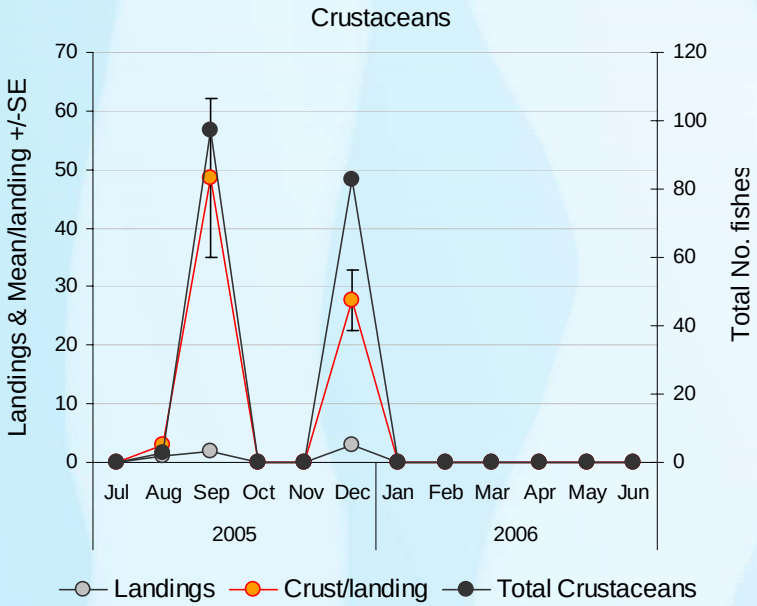
LANDINGS

CRUSTACEANS

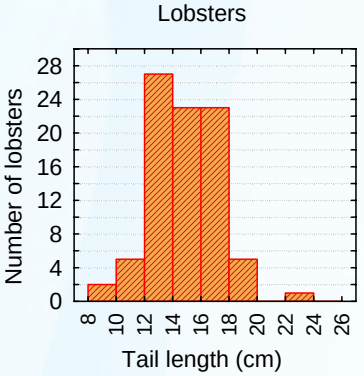
A total of 183 crustaceans were landed and recorded during the survey, accounting for 5% of the total catch of all marine products by number of individuals. Crustaceans included three species of lobsters, two species of marine prawns, and a single species of freshwater prawn.

Crustaceans were present in only 6 of the 775 landings recorded during the survey (0.8%). The greatest number of crustaceans were landed during September and December 2005, with very few at other times. The sizes of the three main groups of crustaceans: lobsters, marine prawns and freshwater prawns were measured using the tail length (cm).

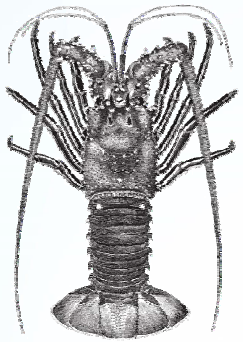
The lobster species identified were the ornate spiny lobster (*Panuliris ornatus*), pronghorn spiny lobster (*P. penicillatus*) and painted spiny lobster (*P. versicolor*). Lobsters averaged 15.4 cm tail length and ranged in size from 10-24 cm. The minimum legal size of lobsters in PNG ranges between 10 cm and 11.5 cm tail length, depending on the species. About 2% of the lobsters landed would have been considered undersized.

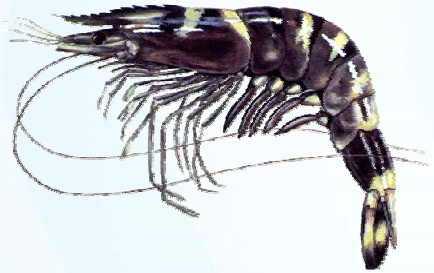


← Average number of crustaceans per landing, number of landings per month and total number of individuals landed over the survey (n=183 crustaceans, 6 landings).



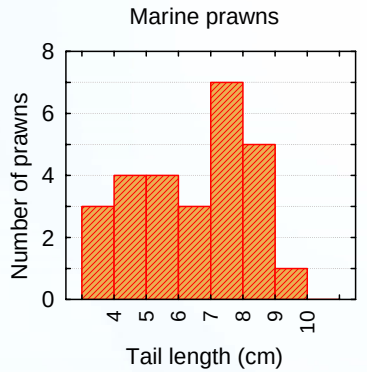
←↓ Sizes of lobsters (n=86), marine prawns (n=27) and freshwater prawns (n=70) landed during the survey.

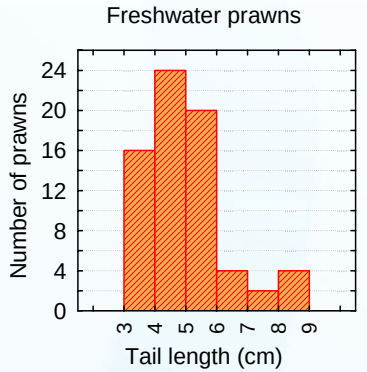




Marine prawns included banana prawns (*Penaeus merguiensis*) and tiger prawns (*P. monodon*). The average size of prawns was 6.5 cm tail length and ranged between 3.5 cm and 9.5 cm. Only a few (27) were landed by fishers coming to Lae, therefore further analysis of their characteristics is difficult.

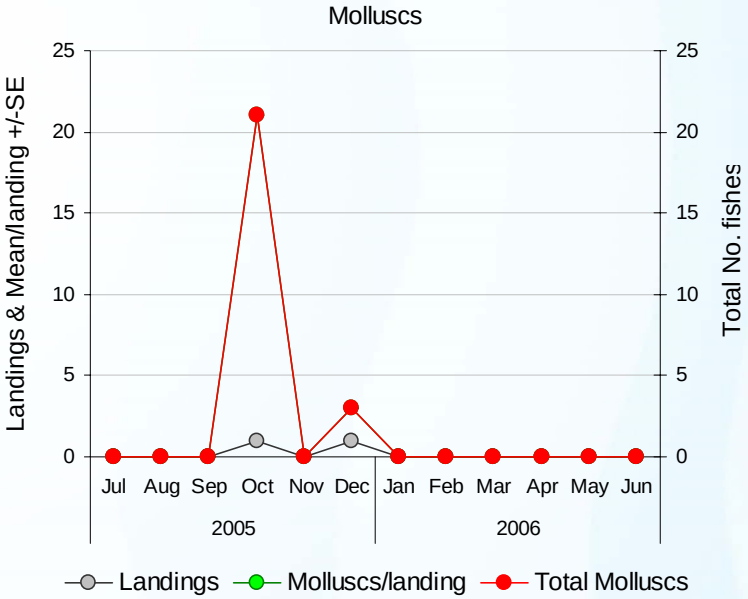
A total of 70 freshwater prawns were landed, all in the genus *Macrobrachium*. Their average size was 5.1 cm tail length and ranged between 3.7 cm and 8.5 cm. Most of the freshwater prawns landed had tail lengths of between 4 cm and 5 cm.

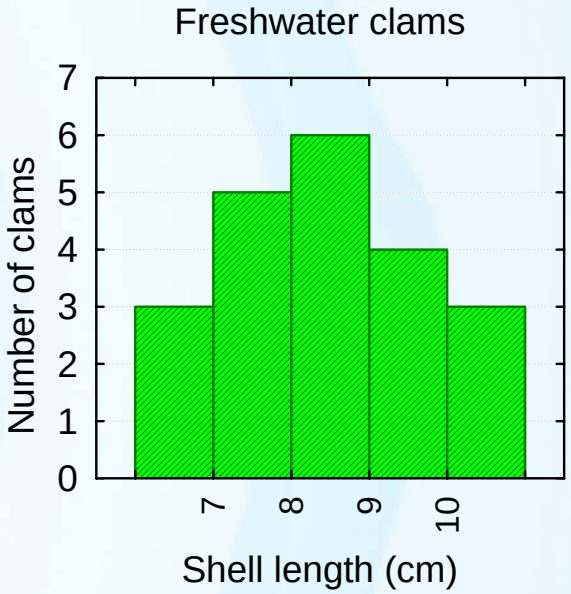




MOLLUSCS

A total of 24 molluscs, including 3 squids and 21 freshwater clams were recorded during the landings survey, accounting for 1% of all marine products landed. These were found in only three landings over the entire survey. Most of the clams were landed in October 2005 (with a few additional ones in December 2005). Squids were landed in July 2005. The average size of clams was 8.9 cm shell length, with a range of 7-11 cm.





← Average number of molluscs per landing, number of landings per month and total number of individuals landed over the survey (n=24 molluscs, 2 landings).

↑ Sizes of freshwater clams landed in Lae during the survey (n=21).

Market Survey

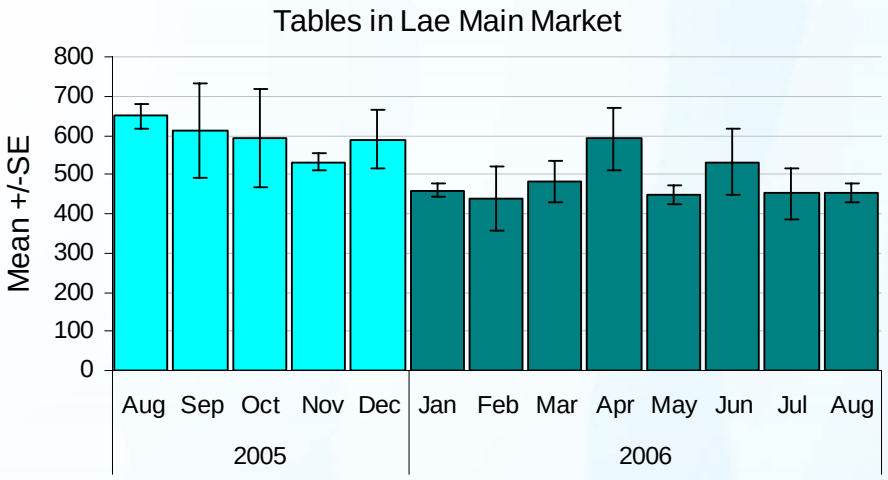
Lae Main Market

Lae Main market had an overall average of 525 tables operating per day (between Monday and Saturday) over the survey period. The number of tables operating at the market varied with time, from around 595 tables per day in 2005 to an average of 482 tables per day in 2006. The maximum number of tables operating on any one day was 1,080 and the minimum was 157.

The most common items on offer were vegetables and fruits (together amounting to 47% of all tables), traditional root crops (including kaukau, yams, cassava and taro) at 17%, and nuts at 7% of all tables. These figures were calculated on the basis of total number of incidences on tables on any one day (and averaged over all samples), regardless of the presence of other items. There appeared to be generally four categories of items in terms of the frequency with which they occurred on tables at the market:

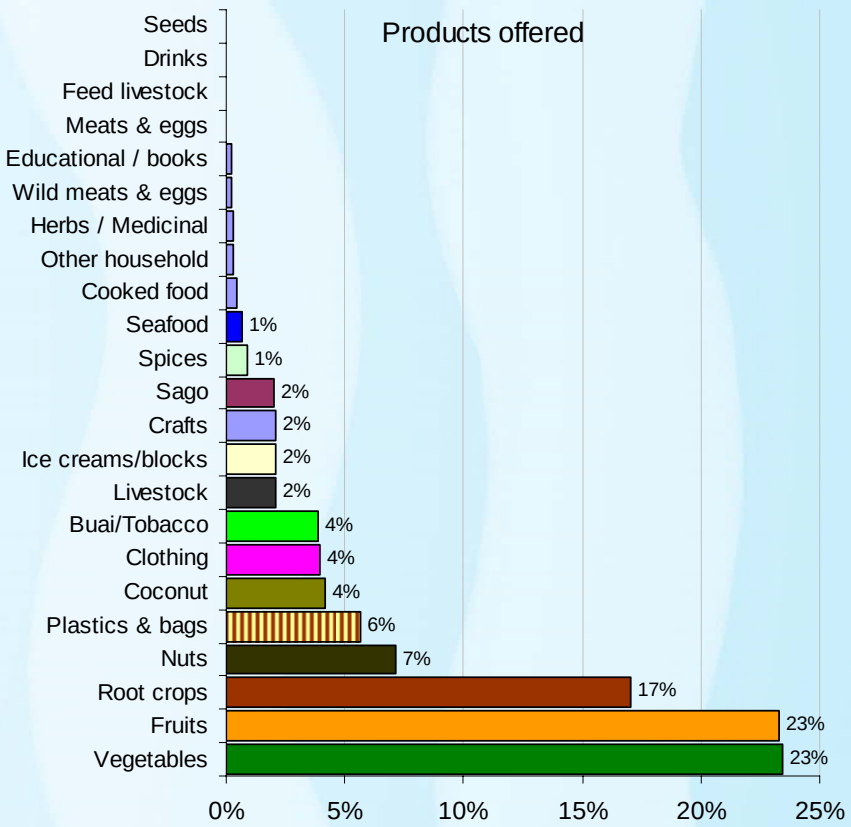
1. Vegetables, fruits and root crops found on more than 64% of all tables;
2. Nuts, coconuts, plastics, clothing, betelnut and tobacco found on 25% of the tables;
3. Livestock (chickens), ice cream/iceblocks, crafts (including billums, baskets and cuscus hair), and processed sago found on 8% of tables; and
4. A range of raw and cooked foods and drinks, other household items, medicinal herbs, spices, books, newspapers and posters, which together were found on 3% of tables.

Overall, marine animals were found on only 1% of tables, but this figure was highly variable on a day-to-day basis.



Number of tables offering all goods at Lae Main Market during the period August 2005 to June 2006. Data are mean number of tables, regardless of the goods on offer +/- SE (n=65 sample days at 5 per month; 34,153 individual tables over the entire period).

Breakdown of the products on offer at Lae Main Market during the survey. Categories are in rank order (n=56,171 observations).



MARKET

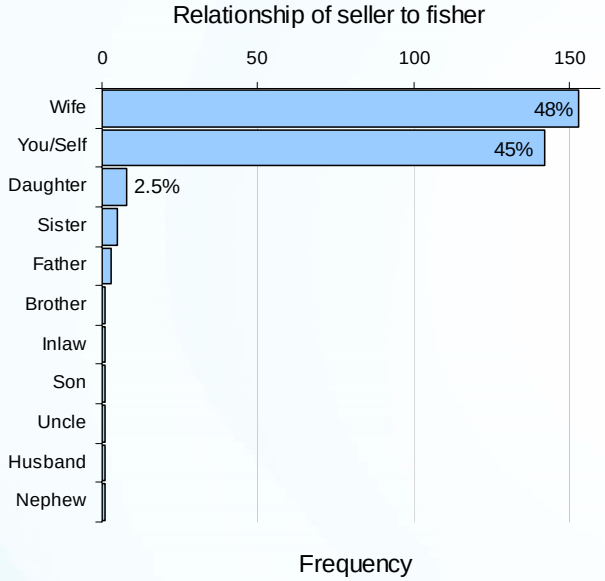
Who are the Sellers?

A total of 2,531 tables were sampled at Lae Main Market between 25 July 2005 and 1 July 2006. Details of sellers, their age and gender, home village, relationship to fishers, and the marine products they were offered for sale were recorded.

Women accounted for 89% of all seafood sellers during the survey. The vast majority of sellers were either the wives of fishers (48%) or were themselves the fishers or collectors of the produce they were selling (45%). The remaining 7% of sellers was mostly made up of the daughters of fishers, with very few sisters, fathers or other family relationships reported. None of the sellers reported they were selling for friends, neighbours, or under any kind of commercial agreement.

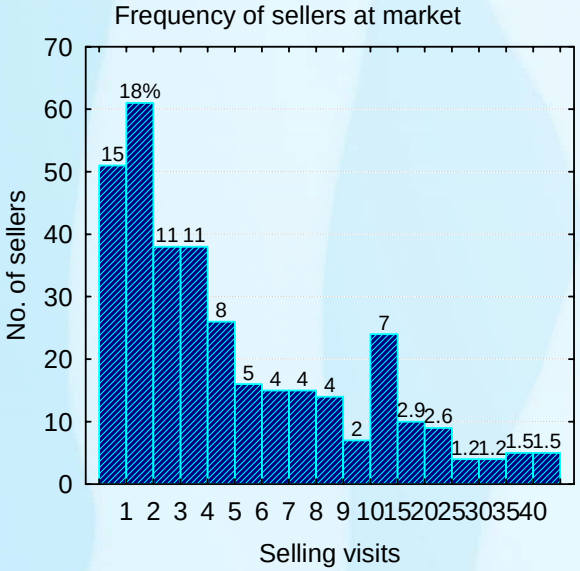
← Age of all sellers interviewed across the market survey (n=344).

↘ Relationship between the sellers we interviewed and the fishers/ collectors who gathered the marine products on offer for sale (n=317).

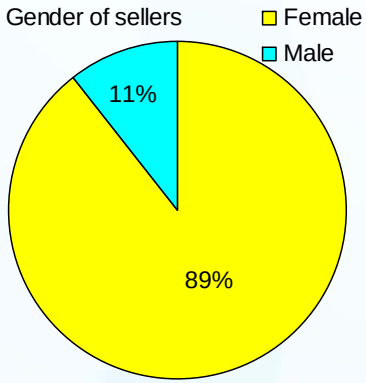


There was a broad range of ages among sellers with ages between 3 and 68 recorded, although there was some inconsistency in ages reported, probably because many were not sure of their age. The younger age groups appear to comprise young children who accompany related sellers and who may assist the adults. The average age of a seller was around 37 years, and the most frequent ages were between 25 and 40 years. More than 30% of the sellers were between 40 and 50 years of age.

The identity of sellers changed constantly. We recorded 342 unique sellers' names over the survey, many of whom (33%) were only recorded once or twice over the 164 sampling days. About 63% of the people surveyed were recorded at the market five times or less over the period of this survey. The average number of times an individual seller was recorded in our samples was 7 times, with the maximum recorded being 83 times.



← Frequency with which different sellers were recorded at market (n=2,531 records from 342 sellers).



→ Gender of sellers at Lae Main Market. Values are percentages of all sellers interviewed over the survey (n=375 people).

Seafood Tables

Between August 2005 and 2006 the number of tables at Lae Main Market offering seafood and other marine products for sale averaged around 5.6 per day, but 74% of the time there were no seafood tables present (excluding lime). The maximum number of tables offering seafood on any one day was 110 (on 2 May 2006). These figures excluded lime sold with buai (betelnut) and which in Lae is usually made from the shells of freshwater clams.

The greatest average daily number of seafood tables observed was in May 2006, based on the five days per month sampling. Between 30 and 83 tables were sampled in detail each month by accumulating data across days. These focused on species on offer, sizes, processing and sale price.

Group	Family	Genus	Species	Number
Molluscs	3	4	4	28,123
Fishes	34	62	97	12,385
Crustaceans	3	4	4	4,855
Total	40	70	105	45,363

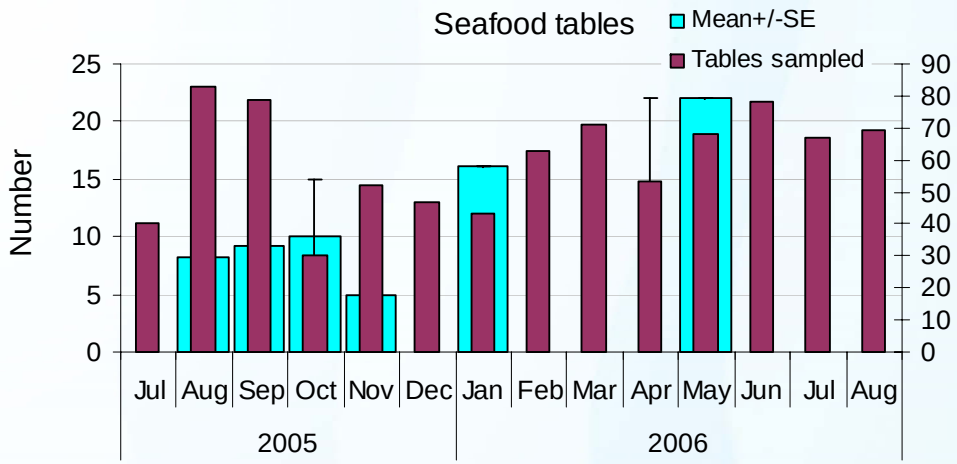
A total of 45,363 marine products were identified, measured and recorded in the detailed surveys during the period 16 July 2005 to 19 August 2006 (164 sampling days). During that time, 843 tables on which seafood were being sold were surveyed.

The largest share of seafood for sale at Lae Main market were molluscs, including freshwater clams, mud snails and squid (62% overall). Fishes accounted for a further 27% of the seafood products offered for sale, with crustaceans (crabs and prawns) accounting for 11%. No other seafood products were offered for sale (e.g. seaweed, turtles, sea cucumbers) during the survey. This does not include information on lime (discussed later in this report), which is processed and cannot be related to the number of animals used. The types of seafood products offered for sale varied slightly over time, but all groups were available in each month.

The most important types of marine animals offered for sale at the main market, were freshwater clams; reef, river and ocean fishes; mud crabs; freshwater prawns; and lime for buai, usually made from freshwater clam shells. Most other types of seafood products were present in much smaller amounts.

Fishes were usually sold whole and may have been gutted and gilled, although occasionally pieces of smoked fishes were offered for sale. Mud crabs were usually offered live with their claws tied. Most of the smaller seafood products were sold individually, or in heaps (e.g. clams), or smoked on skewers. Larger fishes were often sold as cut pieces.

Number of tables in Lae Main Market with seafood for sale during each month of the survey. Blue values are average (means +/- standard error) number of tables per day (left axis) and red values are the total number of tables sampled in each month (right axis).

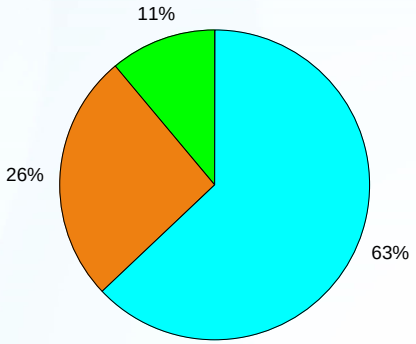


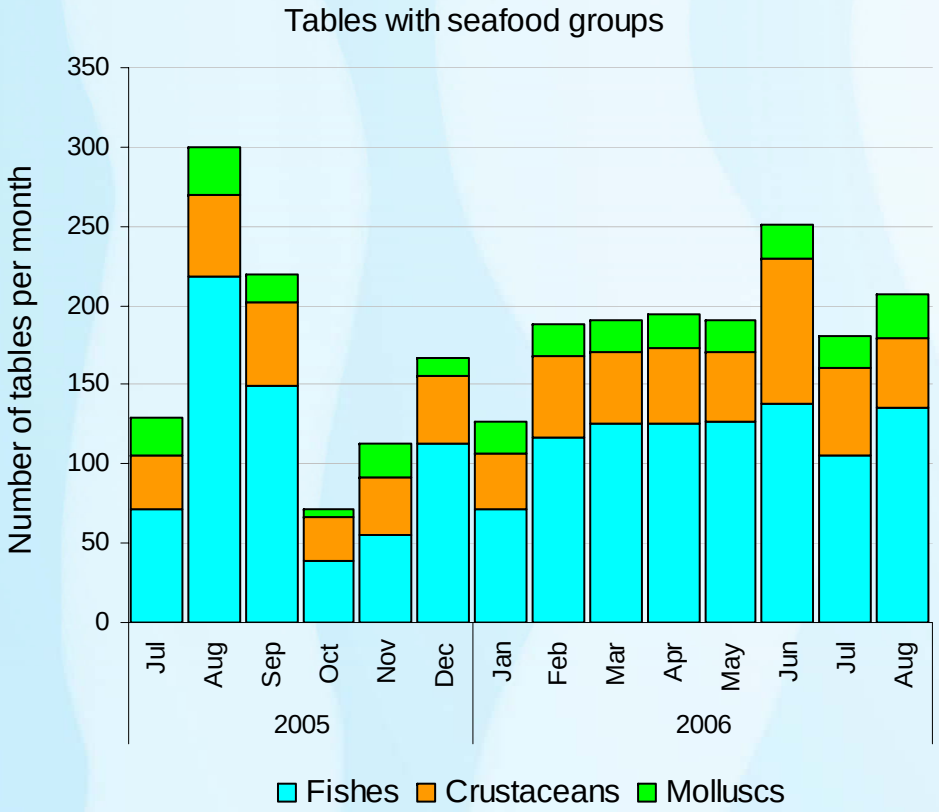
MARKET

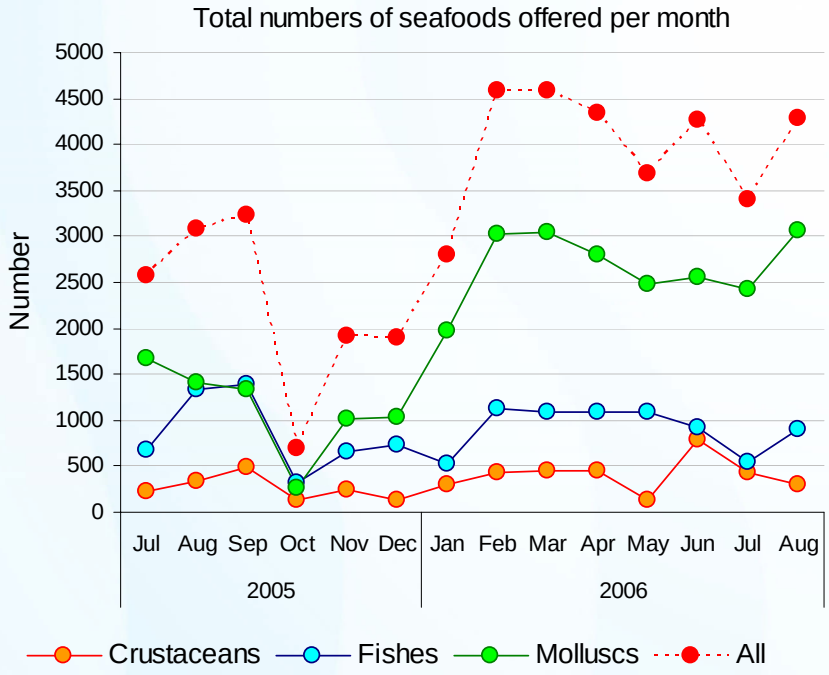
MARKET

Overall, tables offering fishes were the most common of those selling seafoods and accounted for 63% of all tables throughout the survey. The availability of each type of seafood fluctuated throughout the survey. For molluscs, the number of tables offering them on any one day was small, though they were the most numerous seafood item in terms of numbers. Tables offering molluscs were present at the market only 40% of the time and accounted for 11% of all tables offering seafood products. The maximum number of tables offering molluscs on any one day was 16, with only 7 days out of 164 having greater than 10 tables offering them. Tables offering fishes were present on 78% of days, and crustaceans 67% of the time. Seafood tables were most common in August 2005, particularly for fishes, and least common during October of 2005.

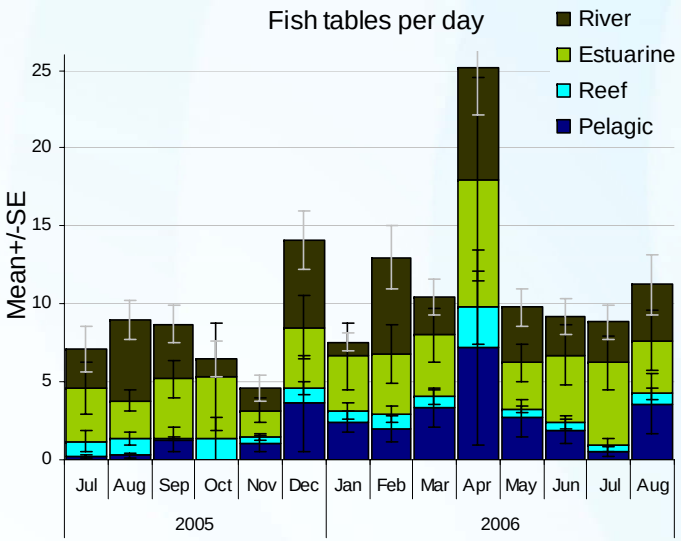
Breakdown of the percent of tables selling different types of seafood at Lae Main Market over the survey period. ➔Top graph is overall, ↙ lower graph shows values broken down by month.

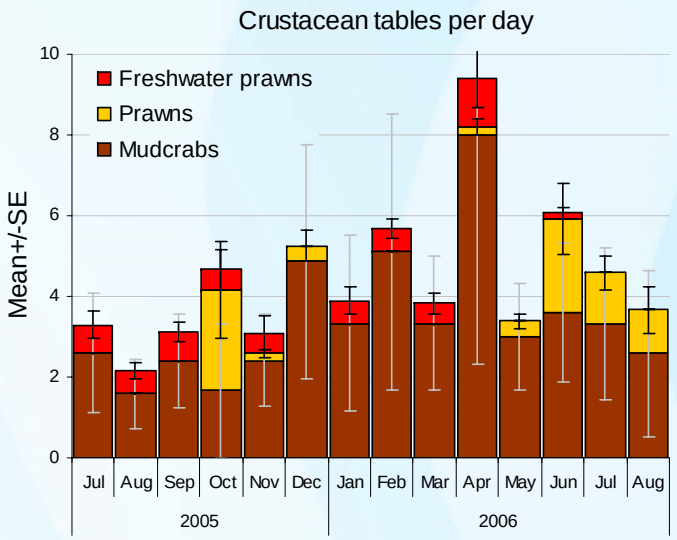


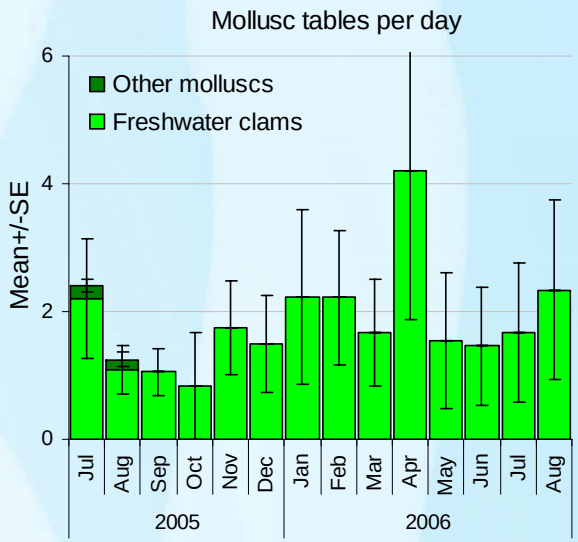




↑ Total numbers of seafood items offered for sale at Lae Main market per month of the survey. Values are broken down by main group of seafood products. Note that the monthly amount of fishes and crustaceans remained relatively stable over the time of the survey. The overall peaks in numbers of seafood products for sale is driven by sporadic numbers of molluscs, usually freshwater clams.







MARKET

Preliminary estimates of the volume of seafood products that could be moving through Lae Main Market were calculated. These calculations were based on the number of tables selling each type of seafood per day, the number of units for sale per table, and the asking price (based on 24 selling days per month). Note that sellers may sell at the end of a day for a lower price, although this was not incorporated into the calculations shown in the table below.

There may have been as many as 23,800 reef and pelagic fishes, over 9,400 crustaceans and over 56,600 clams, and other molluscs sold through the market over the 14-month survey period. These figures, particularly those for the molluscs, should be used with caution as they include estimates of numbers of seafoods offered in pieces, heaps or on skewers in addition to whole individual animals that could easily be counted.

↑ Number of tables in Lae Main Market offering different types of seafood products for sale during each month of the survey. Values are means +/- SE for different groups of marine resources.

The most common types of seafood products sold on tables were estuarine and river fishes, mud crabs and freshwater clams. Reef and pelagic fishes were found on a relatively small number of tables through most of the survey, being most common between March and May 2006.

↓ Summary of calculated volumes of seafood products that may be moving through Lae Main Market per day, month and year. Units refer to the number of fishes, crustaceans or molluscs, regardless of species. Estimates were calculated for each month to incorporate high and low seasons, but remain approximate. Note that columns are not necessarily multiples of each other as they are independently calculated from the best available (and therefore not necessarily the same) information for each measure.

	Tables/day	Units/table	Units/day	Kina/day	Units/month	Units/yr
Fishes	10	7	83	16	1,991	23,893
Crustaceans	4	7	33	12	784	9,408
Molluscs	2	40	197	36	4,717	56,605

MARKET

FISHES

A total of 12,398 fishes were recorded and measured during the market survey. The fishes belonged to 34 families, and included approximately 100 species. The fishes can be approximately divided into four main types in order of overall abundance: river fishes (most common), estuarine fishes, pelagic fishes, and reef fishes (least common). The most common groups of fishes offered for sale at the market were tilapias, mullets, tunas and mackerels, herrings and sardines, and ponyfishes.

The average number of fishes for sale per table, and total number of fishes for sale per month fluctuated over the survey, but did not appear to be changing overall. About 43% of the fishes for sale were smoked and 32% of all fishes were gutted. About one quarter of all the fishes for sale were sold fresh. A few people dried their fishes, but other forms of processing and preservation, such as the use of ice, removing gills, or scaling were not reported.

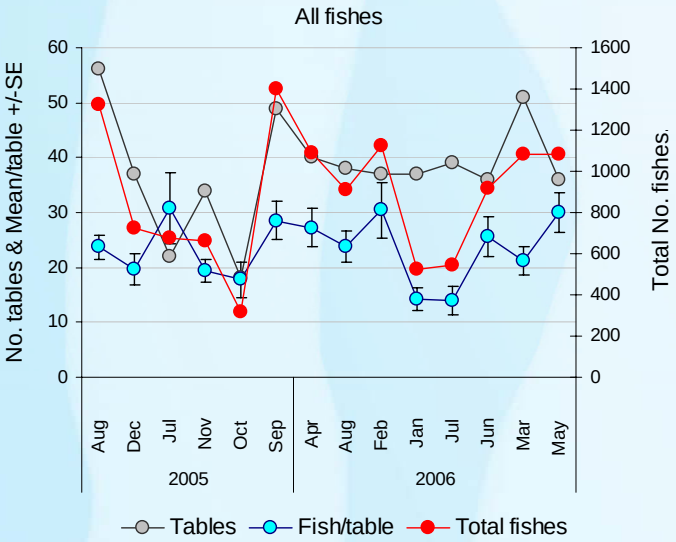
The sizes of fishes sold at Lae Main Market ranged between 2.5 cm and 92 cm, with an average size of 20.5 cm fork length recorded during the survey. About one-half of the fishes for sale were ranged in size from 10-20 cm, with very few fishes recorded at over 40 cm.

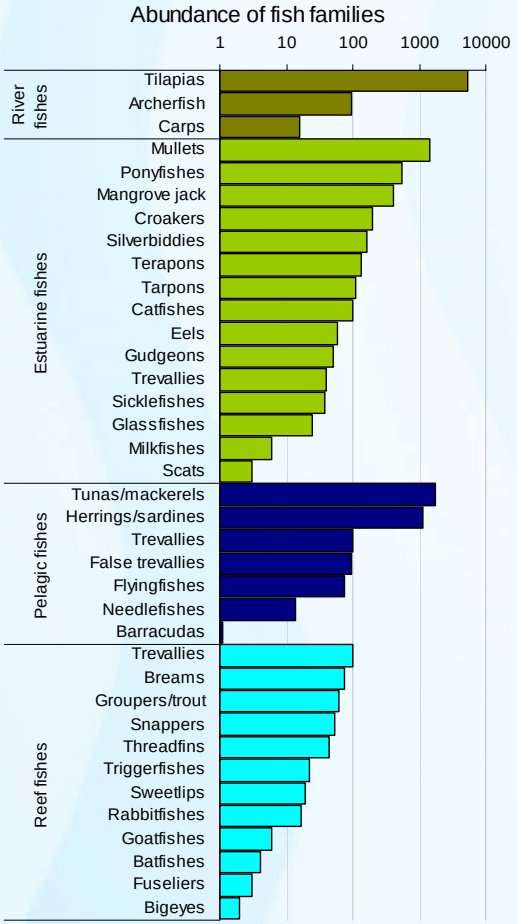
➔ Size distribution of all fishes recorded for sale during the survey across all months (n=12,398).

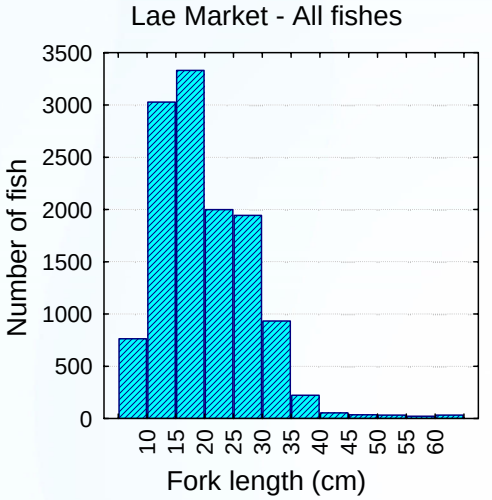
➔ Relative abundance of all fishes families and types.

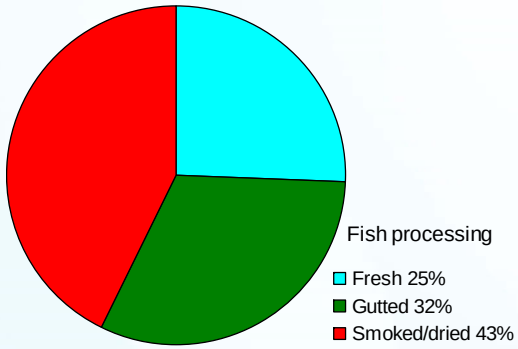
➔ Types of fishes processing used for fishes sold at Lae Main Market. Note these are overlapping categories as any single fishes may be fresh and gutted or smoked and gutted.

➔ Total number of all fishes species per month, average number per table, and number of tables offering fishes during the survey.







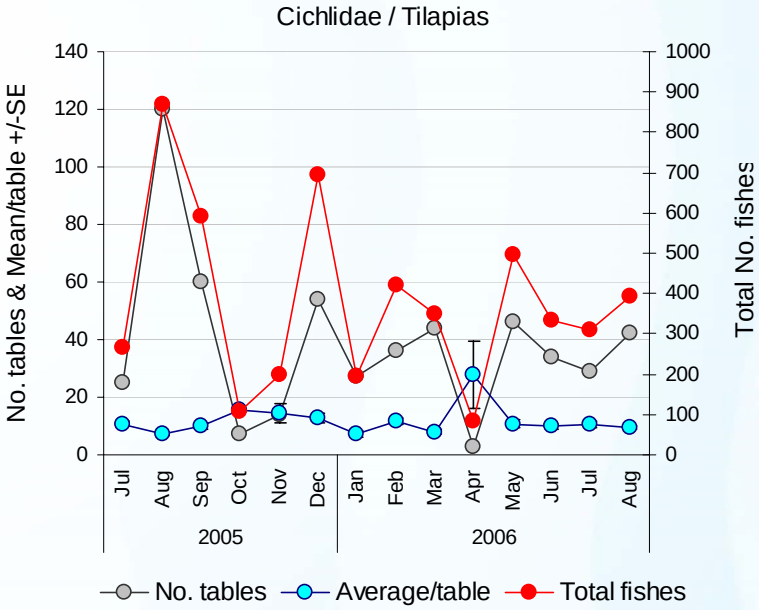


FISHES > Cichlidae / Tilapias

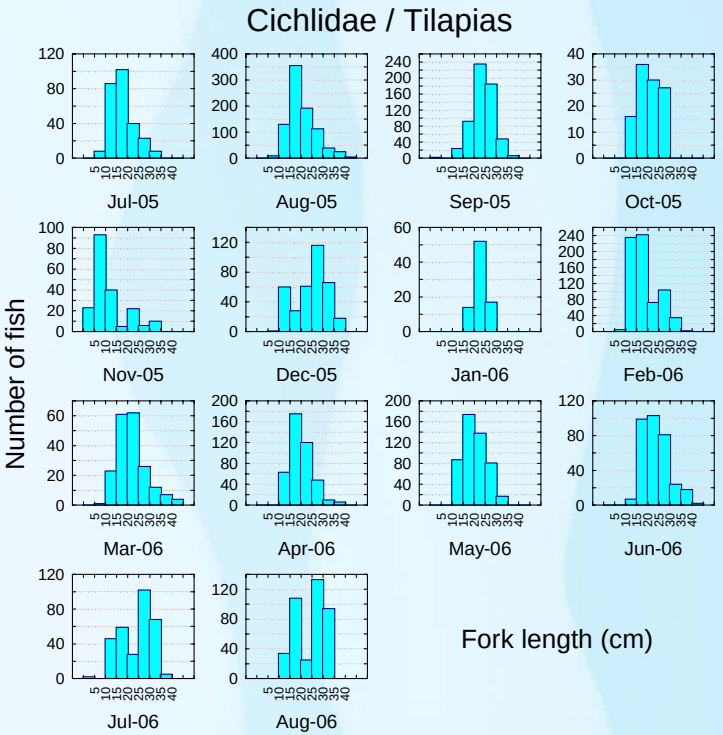
Tilapias are freshwater to brackish water fishes that were first introduced from Africa and now found in rivers, lakes and estuaries around PNG. Most of the fishes we recorded were *Oreochromis mossambicus*, though there may be other species present. Tilapias were the most common fishes for sale in Lae Main market, with 5,317 being offered on 541 tables during the survey, accounting for 43% of all fishes being sold. The tilapias were brought to Lae main Market from the Sepik River and surrounding lakes, Lake Wanam, and rivers and estuaries including the Markham River.

On average, there were about 10 tilapias for sale on each table that offered fishes from this family. Overall, 64% of all seafood tables included tilapias, though this varied by month. High periods were noted in August-September and December of 2005.

The average size of tilapias was 21.6 cm fork length, and ranged up to 57 cm. Most of the fishes were between 15 cm and 20 cm overall. The majority of tilapias (72%) were offered for sale smoked, with smoked fishes tending to be smaller than fresh fishes.

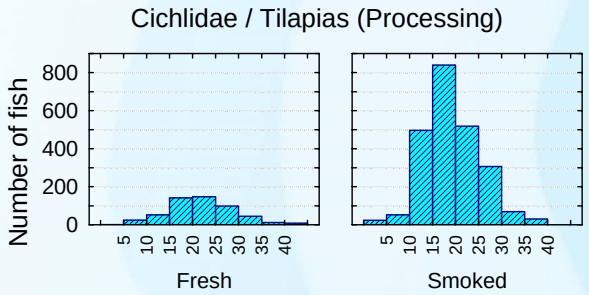


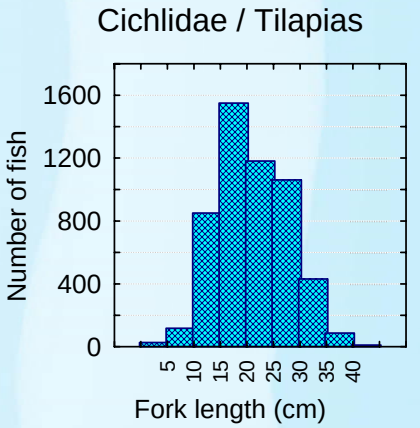
↙ Average number of tilapia per table, number of tables per month, and total number of individuals offered in Lae Main Market over the survey (n=541 tables).



↘ Size distribution of tilapias in Lae Main Market during the survey, and ↑ broken down by sampling month (n=5,317 fish).

↓ Sizes of fresh and smoked fish offered in Lae Main market.





MARKET

MARKET

FISHES > Scombridae / Tunas and mackerels

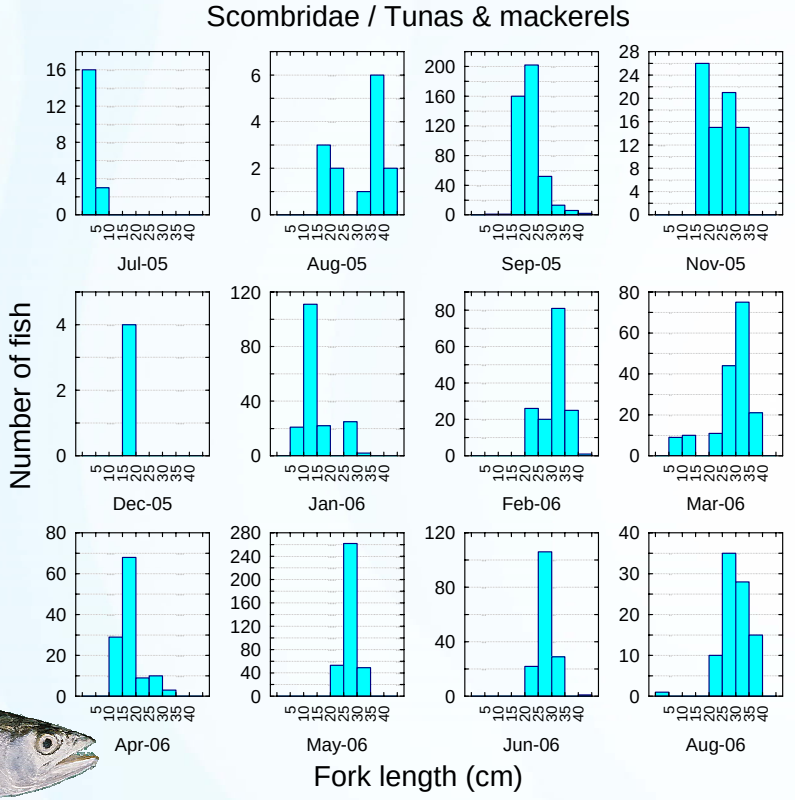
Tunas and mackerels (scombrids) were the second most important family (after tilapias) offered for sale at Lae Main Market, being found on 18% of all tables surveyed and accounting for 14% of all seafood products by count. There was an average of 11 tables per market day offering fishes from this family. On each table there was an average of 12 fishes, reaching a maximum of 64 fishes during the survey. A total of 1,785 of these fishes was recorded over a total of 154 tables throughout the survey period, with the greatest number and averages recorded in September 2005.

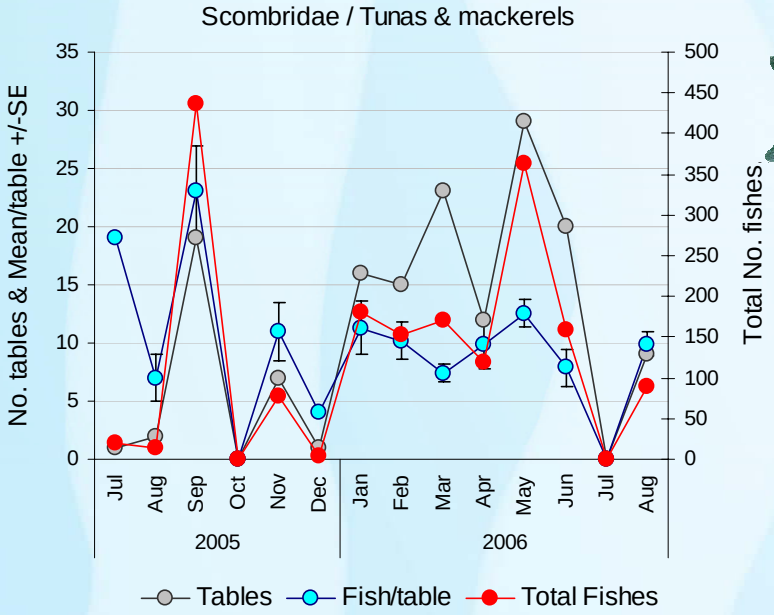
Scombrids ranged in size between 3 cm and 41 cm fork length, averaging 24 cm. These measures do not give a complete picture, however, as larger fish tended to be cut into pieces for sale and could not be measured. It is likely that the larger sizes of these fish is underestimated in the market survey. Most of these fishes were offered smoked, with only 4% of fish offered fresh.

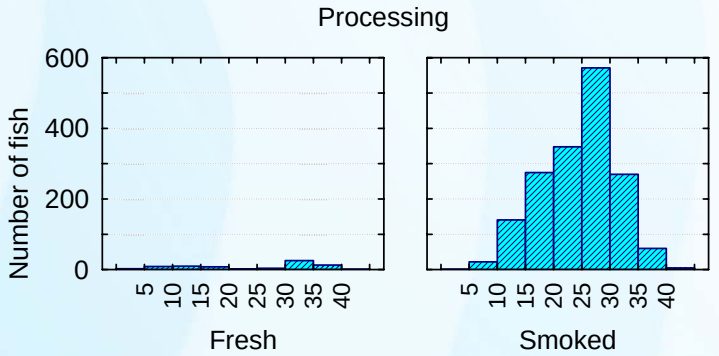
↘ Size distribution of scombrids in Lae Main Market during the survey, and broken down by sampling month (n=1,785 fishes).

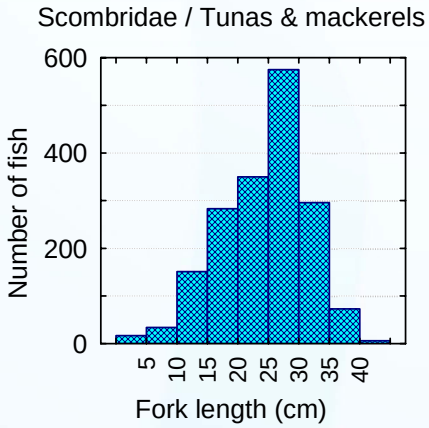
↙ Average number of scombrids per table, number of tables per month and total number of individuals offered in Lae Main Market over the survey (n=154 tables).

↓ Sizes of fresh and smoked fishes offered in Lae Main market.







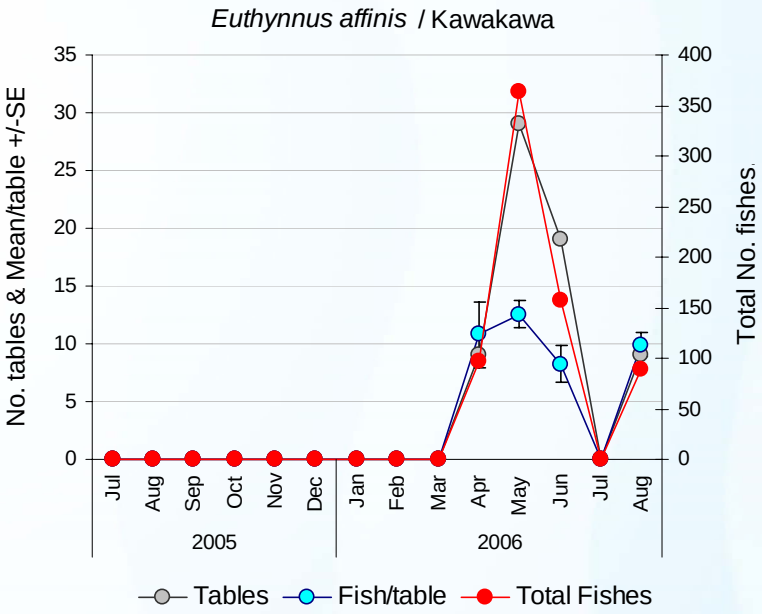


FISHES > Scombridae / Tunas > *Euthynnus affinis* / Kawakawa

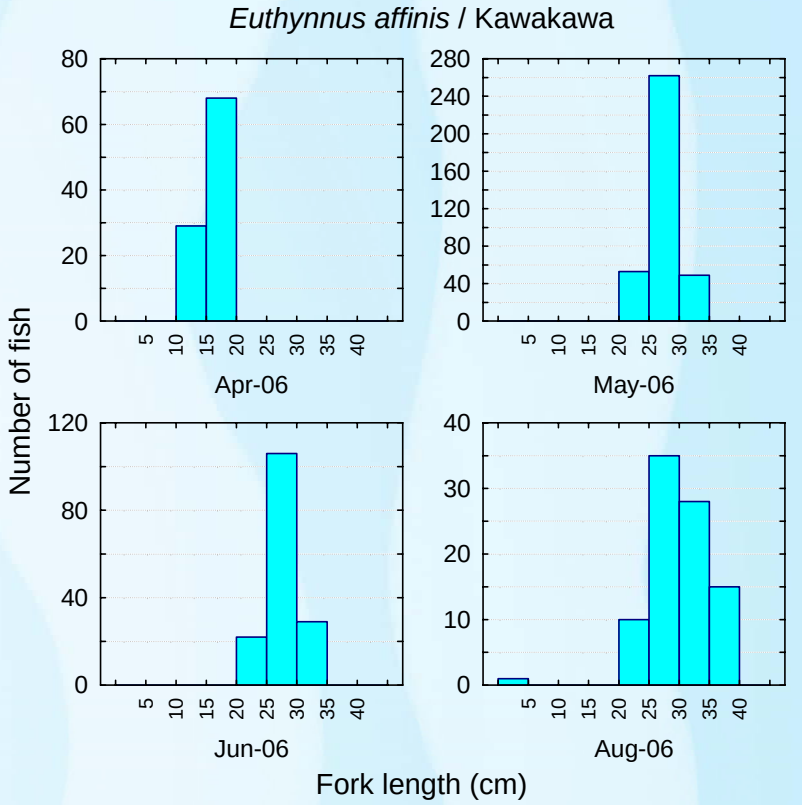
Kawakawa only appeared for sale at the market in the period April to August 2006. During that time, it was common and ranked as the fourth most abundant species in the survey (6% of all fishes). Overall, 707 of these tunas were recorded from a total of 66 tables (8% of all tables).

The average size of these fish was around 27 cm fork length and ranged between 5 cm and 37 cm. Most fish (57%) were between 25 cm and 30 cm in length, but this is likely to be a poor estimate of the sizes of this fish. Most of the larger specimens would have been offered for sale as pieces and could not be measured. The maximum size recorded for this species is 100 cm and the size at maturity is between 40 cm and 65 cm.

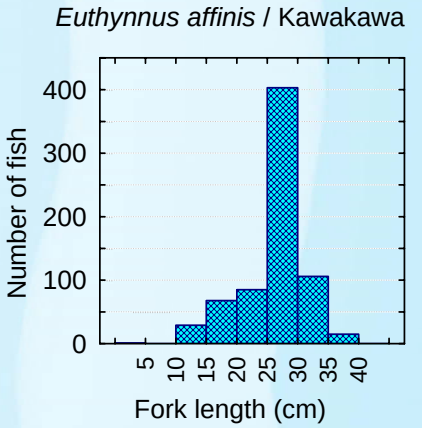
All of the kawakawa for sale at Lae Main Market were offered as smoked fish.



← Average number of kawakawa per table, number of tables per month and total number of individuals offered in Lae Main Market over the survey (n=66 tables).



➔ Size distribution of kawakawa in Lae Main Market during the survey, and ↗ broken down by sampling month (n=707 fish measured).



MARKET

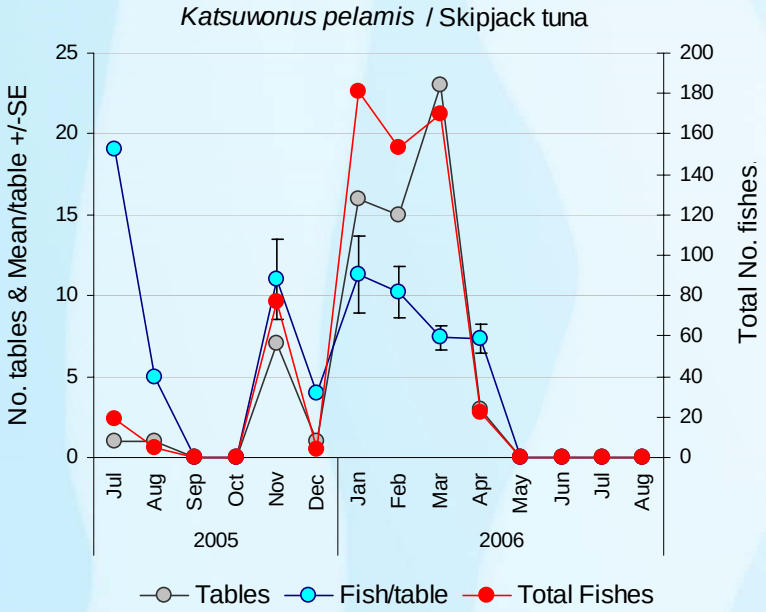
MARKET

FISHES > Scombridae / Tunas > *Katsuwonus pelamis* / Skipjack tuna

Skipjack tuna accounted for around 5% of fishes offered for sale in Lae Main Market. These fish were present on around 8% of all seafood tables surveyed. The number offered for sale varied significantly by month, with the greatest numbers on offer from January-March 2006 and generally low numbers, or absent, in most months. Peaks in numbers available appeared to be driven both by the number of tables and the number of fish per table.

The average size of skipjack tunas being sold was 24 cm fork length, and reported sizes ranged between 3 cm and 56 cm over the survey. A total of 19 fishes was recorded at 10cm fork length or less, which is an unlikely result for this species. It is likely that some fish were misidentified in July 2005, early in the sampling program.

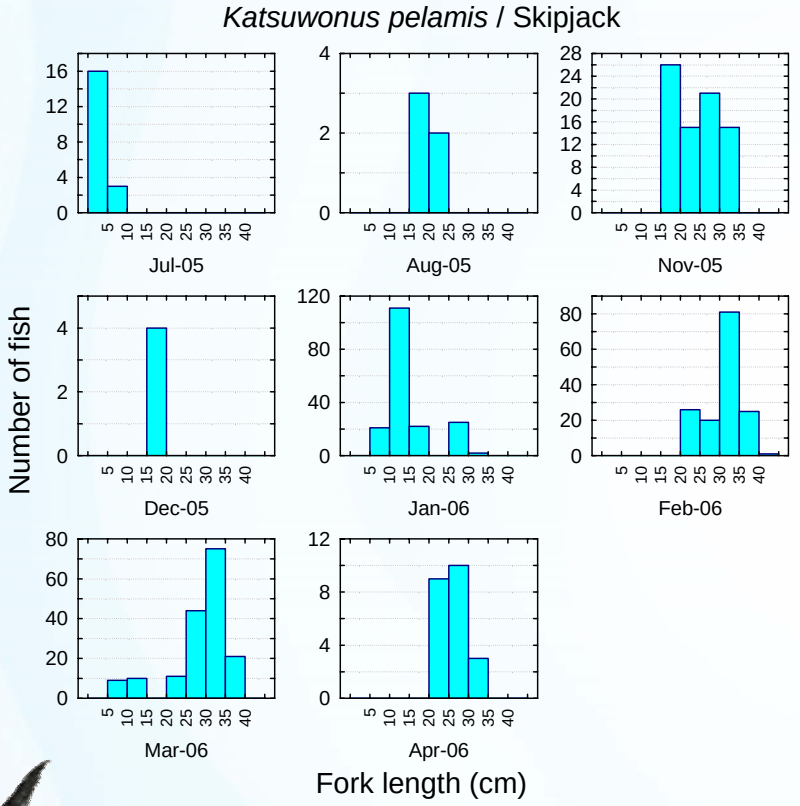
Fish fell into two distinct size groups overall, with large numbers of fishes 10-15 cm and 30-35 cm long. Almost 90% of all skipjack were offered for sale smoked.

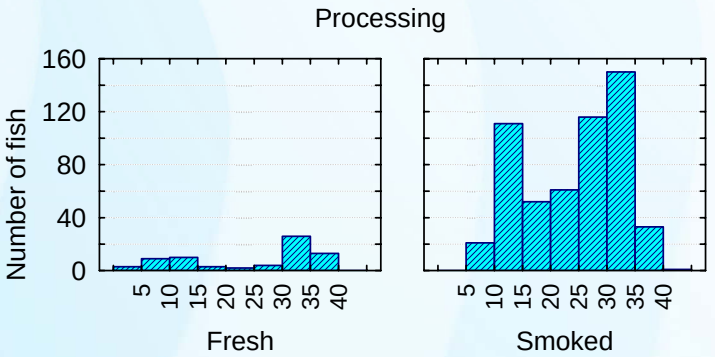


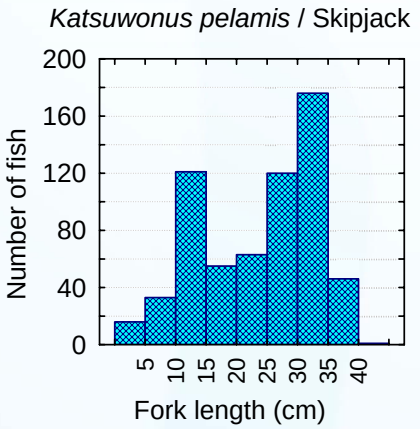
↘ Size distribution of skipjack tunas in Lae Main Market during the survey, and broken down by sampling month (n=631 fish).

↙ Average number of skipjack tunas per table, number of tables per month and total number of individuals offered in Lae Main Market over the survey (n=67 tables).

↓ Sizes of fresh and smoked fish offered in Lae Main market.







FISHES > Mugilidae > Mullets

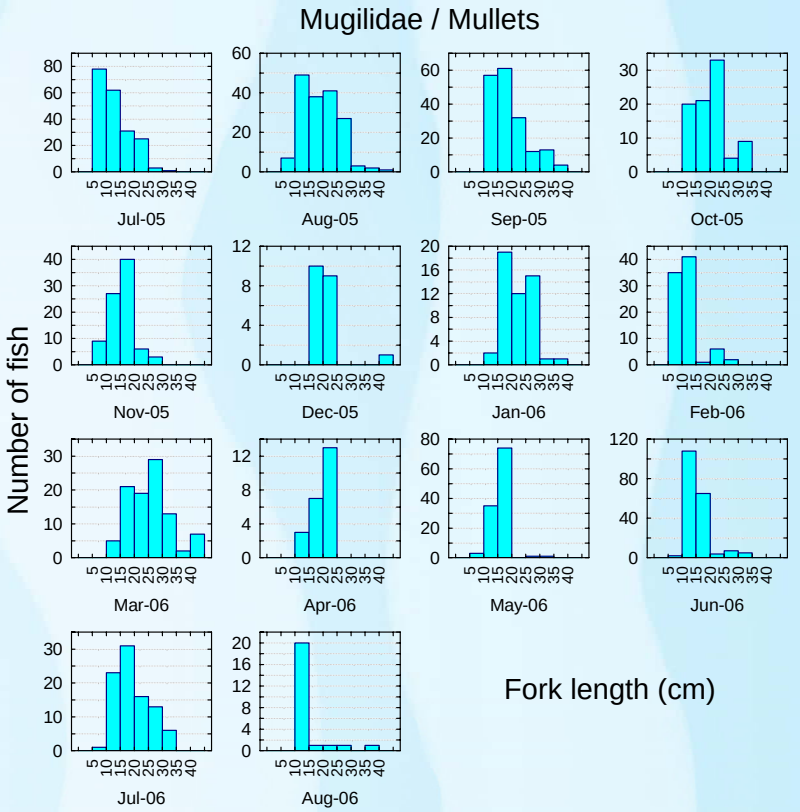
Overall, 1,412 mullets of a range of species were counted across a total of 204 tables during the survey. The number of tables selling these species changed significantly during the survey, with peaks in August 2005 (33 tables per day) and July 2006. The average number of fish per table remained relatively constant throughout the survey, averaging 7 fishes per table per day, with a peak in February 2006. Total numbers of fishes for sale during any month was highly correlated with the number of tables (sellers).

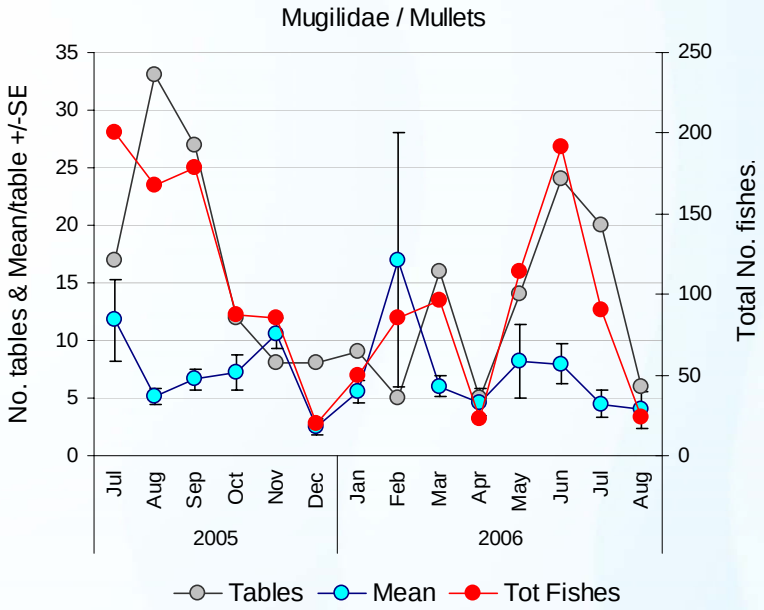
The average size of these fishes was around 18 cm fork length and ranged between 6 cm and 52 cm. Most fishes (62%) were between 10 cm and 20 cm in length. Most mullets were offered for sale fresh, with about 17% offered smoked.

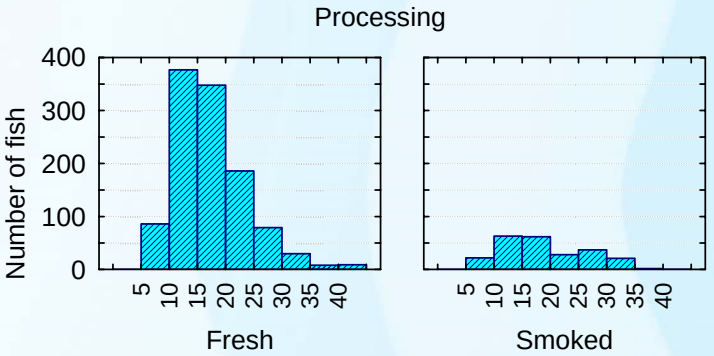
↘ Size distribution of mullets in Lae Main Market during the survey, and broken down by sampling month (n=1,412 fishes measured).

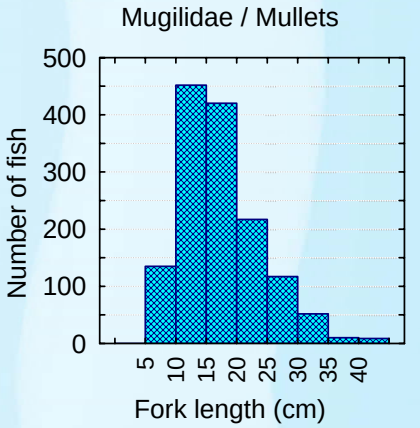
↙ Average number of mullets per table, number of tables per month and total number of individuals offered in Lae Main Market over the survey (n=204 tables).

↓ Sizes of fresh and smoked fishes offered in Lae Main market.









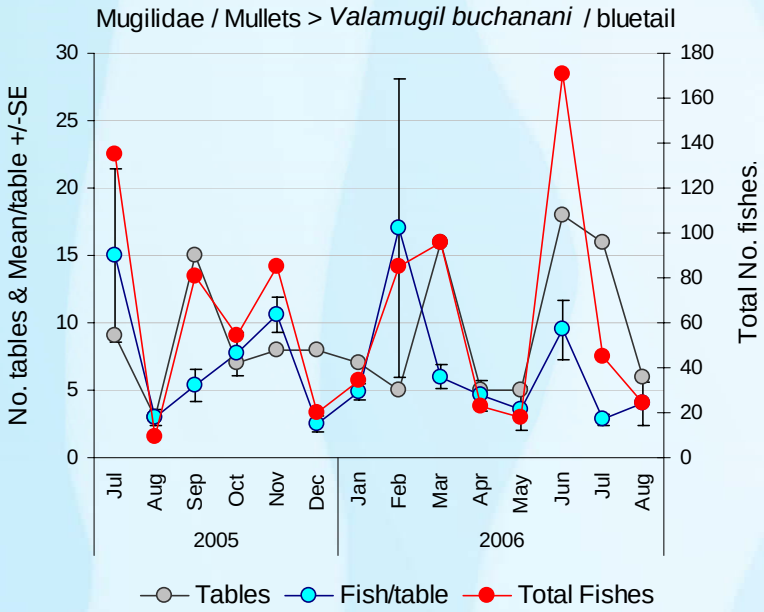
MARKET

MARKET

FISHES > Mugilidae / Mullets > *Valamugil buchanani* / Bluetail mullet

Bluetail mullets accounted for around 7% of the fishes offered for sale in Lae Main Market, and were the second most common species recorded. Bluetail mullets were present on around 15% of the tables surveyed. The total numbers offered for sale varied by month of the survey, with the greatest numbers on offer in June-July of each year. Generally, the peaks in the number of available bluetails appeared to be the result of greater numbers found on individual tables, rather than a greater number of tables offering them.

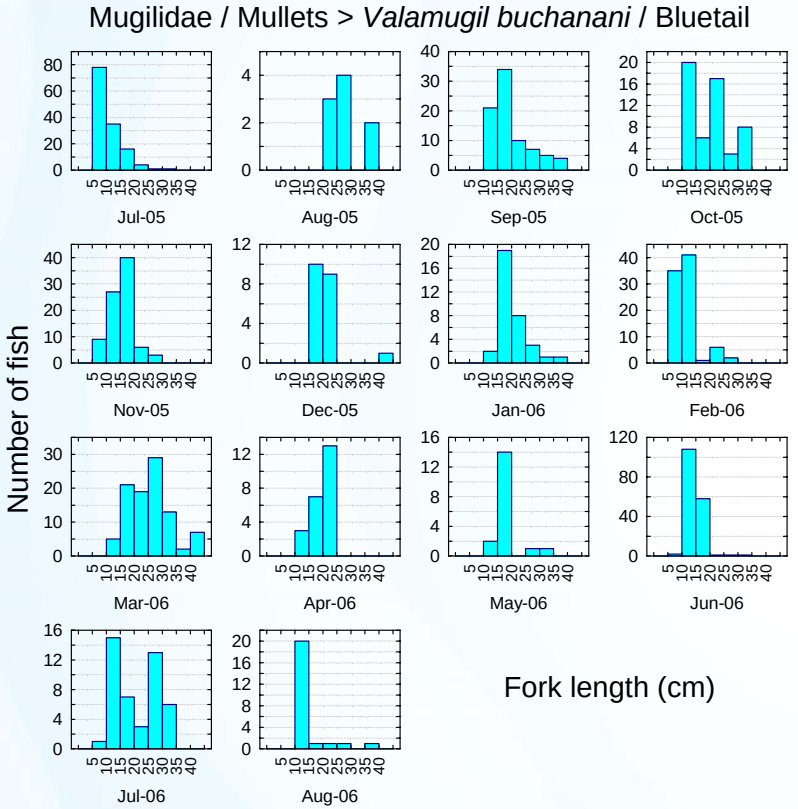
The average size of bluetail mullets being sold was 17 cm fork length, and ranged between 6 cm and 52 cm over the survey. Over 34% of the fish measured were between 10 cm and 15 cm long. About 83% of all bluetails were offered for sale fresh.

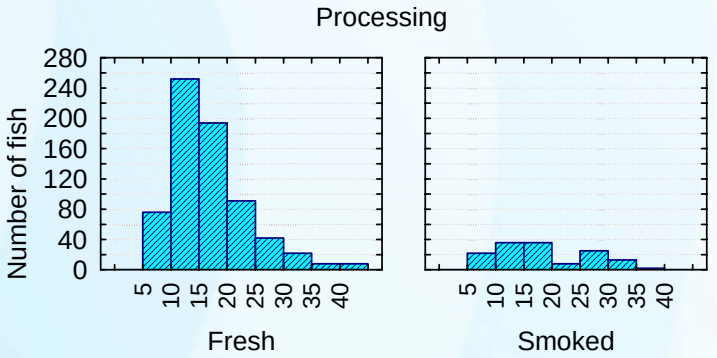


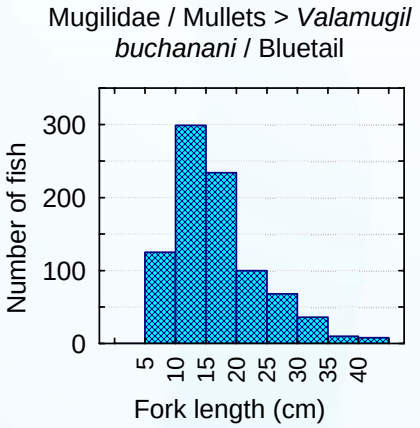
↘ Size distribution of bluetail mullets in Lae Main Market during the survey, and broken down by sampling month (n=2,047 fish).

↙ Average number of bluetail mullets per table, number of tables per month. and total number of individuals offered in Lae Main Market over the survey (n=128 tables).

↓ Sizes of fresh and smoked fish offered in Lae Main market.





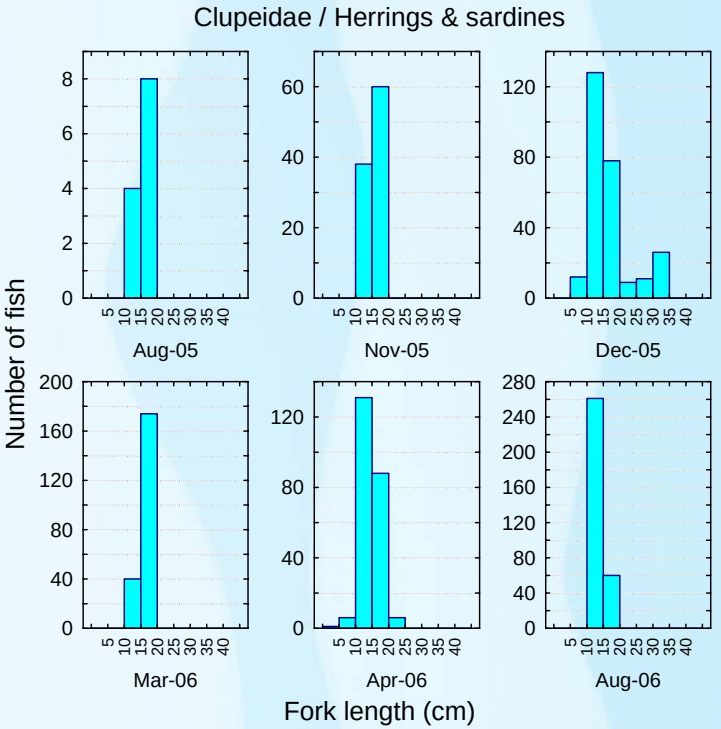


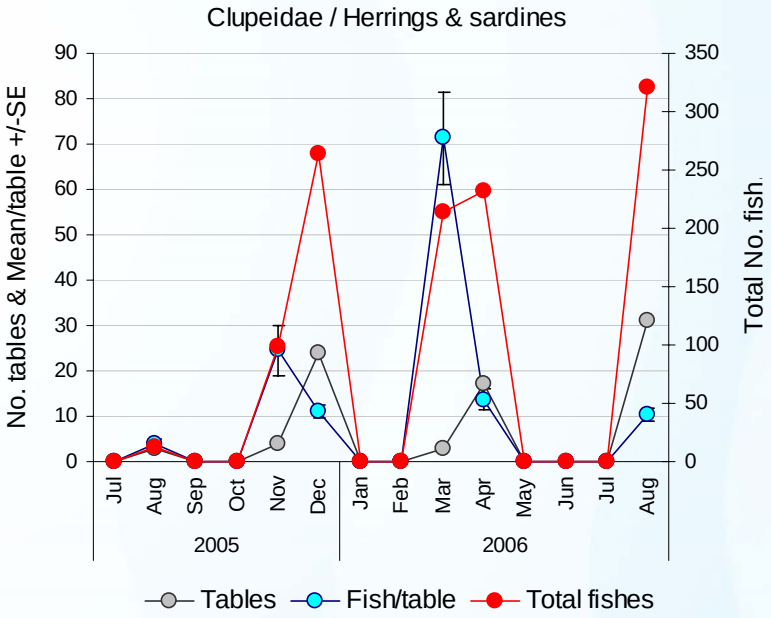
FISHES > Clupeidae / Herrings, sardines, shads & sprats

This group of fishes was the fourth most abundant family in the survey. It includes herrings, sardines, shads and sprats, some of which are used elsewhere as bait, but are probably in Lae Main Market mostly for human consumption (many are smoked). A total of 1,141 fishes of this family were recorded, accounting for 9% of all fishes on offer. Herrings and sardines were found on 10% of all tables surveyed, a total of 82 tables. The average number of fishes found on the tables was 14, but ranged up to 88.

The average size of these fishes was 16 cm fork length, but was made up of a mixture of small river sprats, shads and other species that grow to larger sizes. The size range was between 5 cm and 35 cm, but most fishes were between 10 cm and 20 cm. Most of the fishes in this family (>89%) were offered for sale smoked.

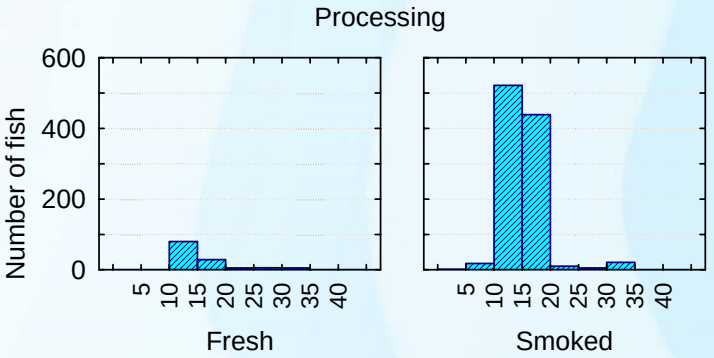
↘ Size distribution of herrings & sardines in Lae Main Market during the survey, and broken down by sampling month (n=1,207 fish).

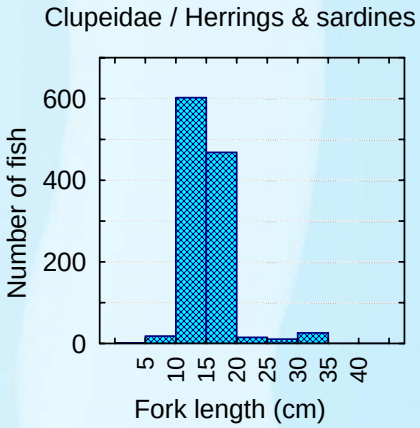




↙ Average number of herrings and sardines per table, number of tables per month of the survey and total number of individuals offered in Lae Main Market over the survey (n=82 tables).

↓ Sizes of fresh and smoked fishes offered in Lae Main Market.





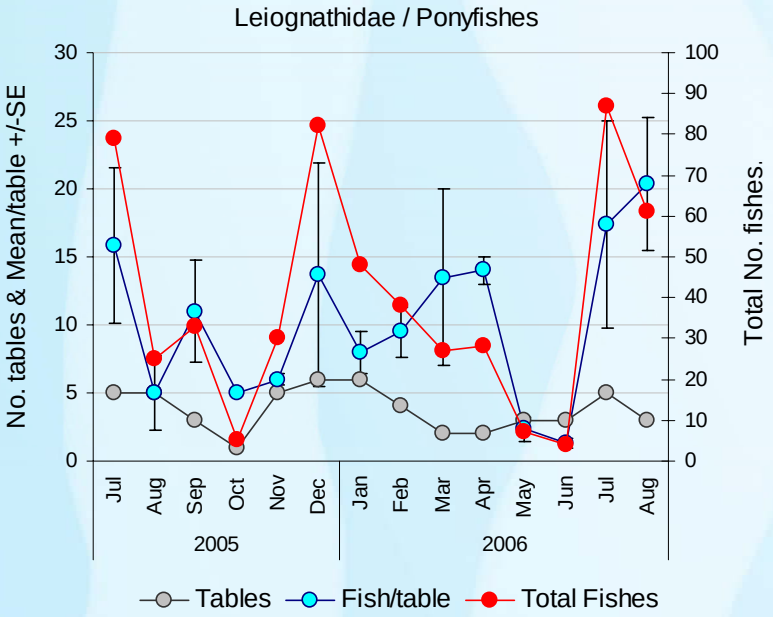
MARKET

MARKET

FISHES > Leiognathidae / Ponyfishes

A total of 554 ponyfishes were recorded on 53 tables at Lae Main Market during the survey. These fishes accounted for about 4% of all fish offered for sale, and were found on about 6% of tables. There was an average of 10 fishes per table, but reached a maximum of 51 over the survey. There were significant differences in the number of ponyfishes available at the market across the months of the survey. These fishes were rare in October 2005 and May-June 2006, but were more abundant during mid year and in December 2005.

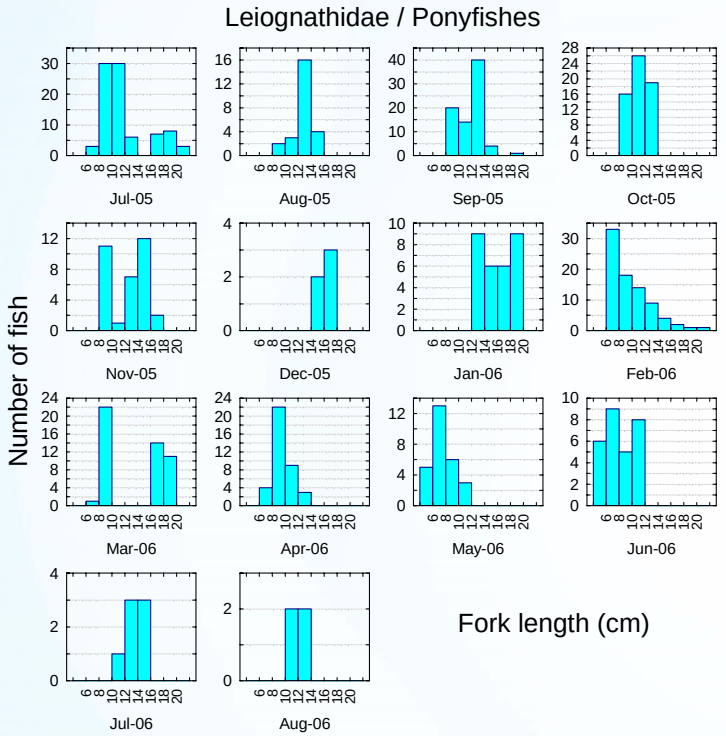
The average length of ponyfishes was 11.8 cm and individuals ranged between 5 cm and 29 cm. Most of these fishes were sold fresh (70%).

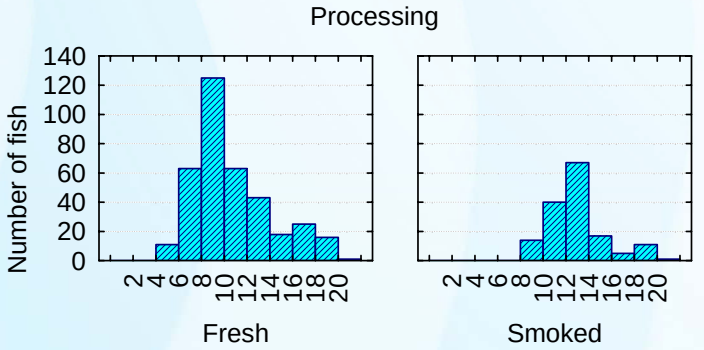


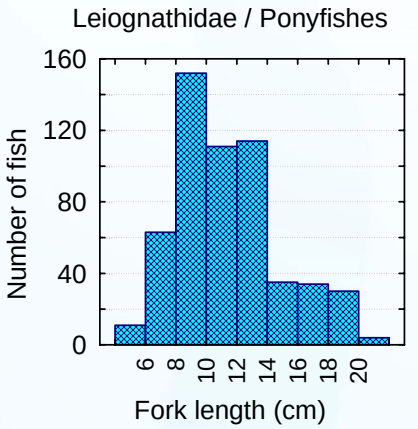
↘ Size distribution of ponyfishes in Lae Main Market during the survey, and broken down by sampling month (n=554 fishes measured).

↙ Average number of ponyfishes per table, number of tables per month of the survey and total number of individuals offered in Lae Main Market over the survey (n=53 tables).

🡻 Sizes of fresh and smoked fishes offered in Lae Main market (n=520).



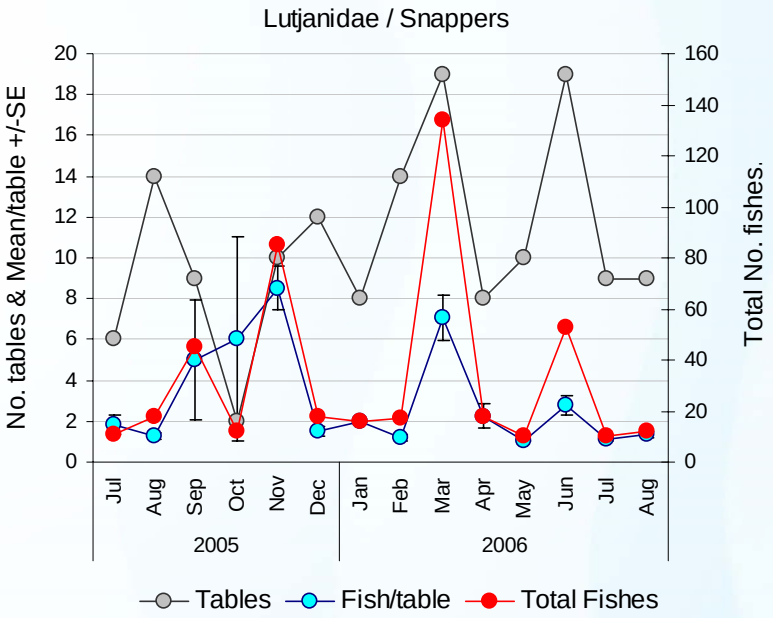




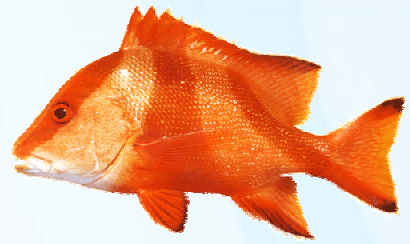
FISHES > Lutjanidae / Snappers

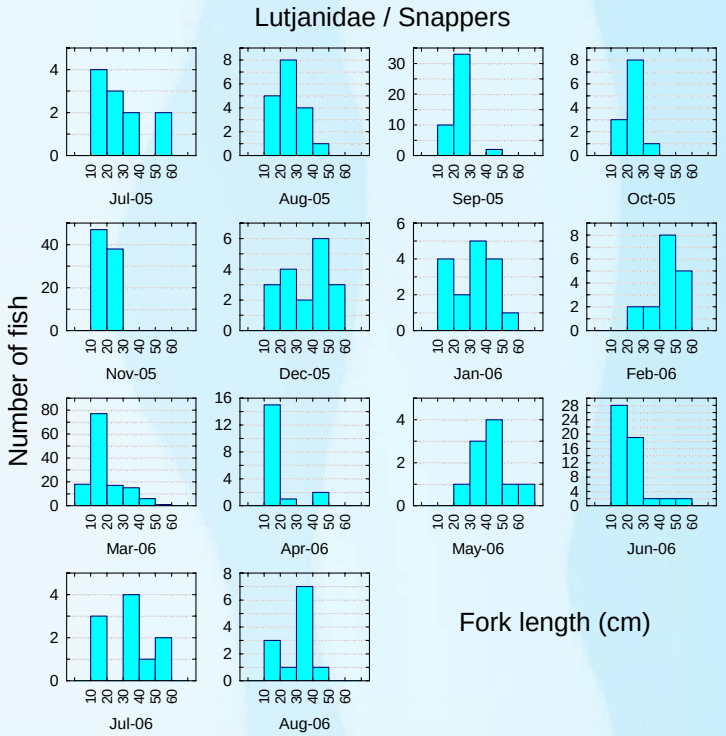
Snappers were the sixth most common family of fishes found at Lae Main Market during the survey. A total of 459 snappers from 9 species were recorded from over 149 tables. The average number of these fishes on tables was 3 and ranged up to 28. The average number of fishes per table also fluctuated over the period of the survey, as did the total number available per month and the number of tables offering them. Snappers were most common in Lae Main Market in November 2005 and March 2006.

The average fork length of snappers was 24 cm during the survey, and ranged between 8 cm and 62 cm. Most fishes were between 10 cm and 20 cm long. Over 80% of the snappers offered for sale in Lae Main Market were sold fresh, with most of the remainder were sold smoked.



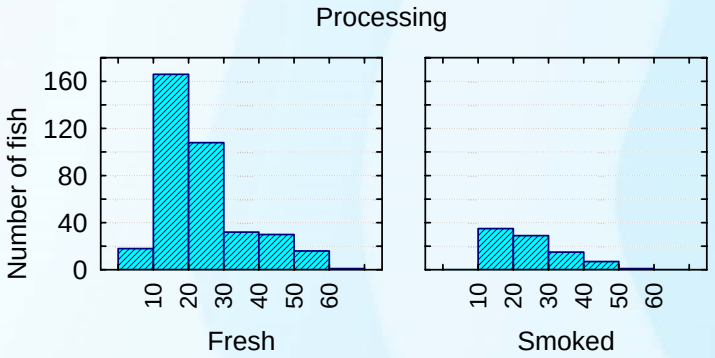
Size distribution of snappers in Lae Main Market during the survey, and broken down by sampling month (n=459 fishes).

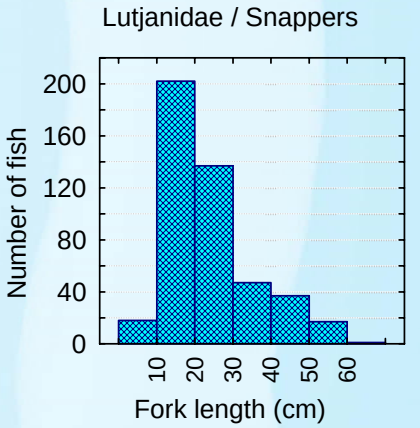




Average number of snappers per table, number of tables per month of the survey and total number of individuals offered in Lae Main Market over the survey (n=149 tables and 459 fishes counted).

Sizes of fresh and smoked fishes offered in Lae Main market.





MARKET

MARKET

FISHES > Lutjanidae / Snappers > *Lutjanus argentimaculatus* / mangrove jack

In total, 406 mangrove jacks were recorded from 125 tables during the survey. The total number in the market varied significantly by month, with numbers related to the number of tables offering them and to a lesser degree to the number available on each table. The average number of mangrove jacks offered for sale on tables was around 3.2, and ranged up to 28, with the greatest number of fish per table recorded in March 2006 (134 fish, with an average of 7 per table).

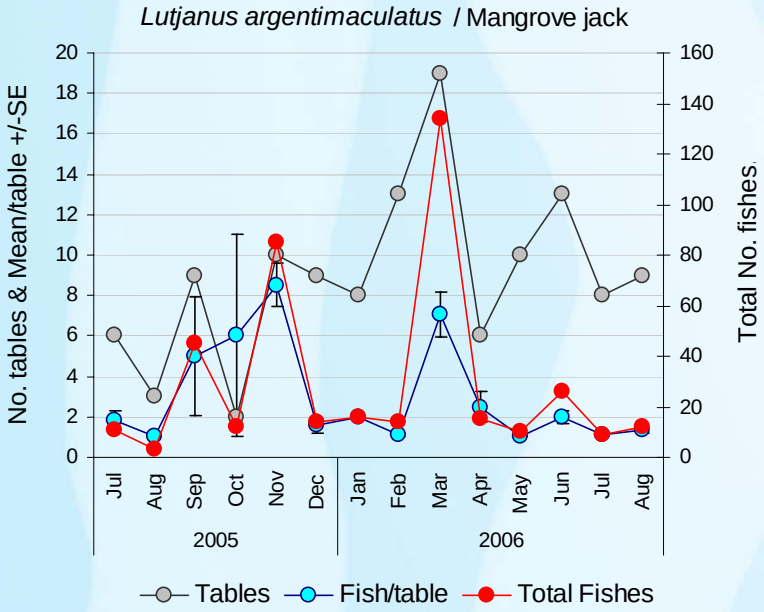
The average length of mangrove jacks offered for sale was 23.8 cm, and ranged between 8 cm and 62 cm. Most of these fish were sold fresh (87%).

↘ Size distribution of mangrove jacks in Lae Main Market during the survey, and broken down by sampling month (n=406 fish).

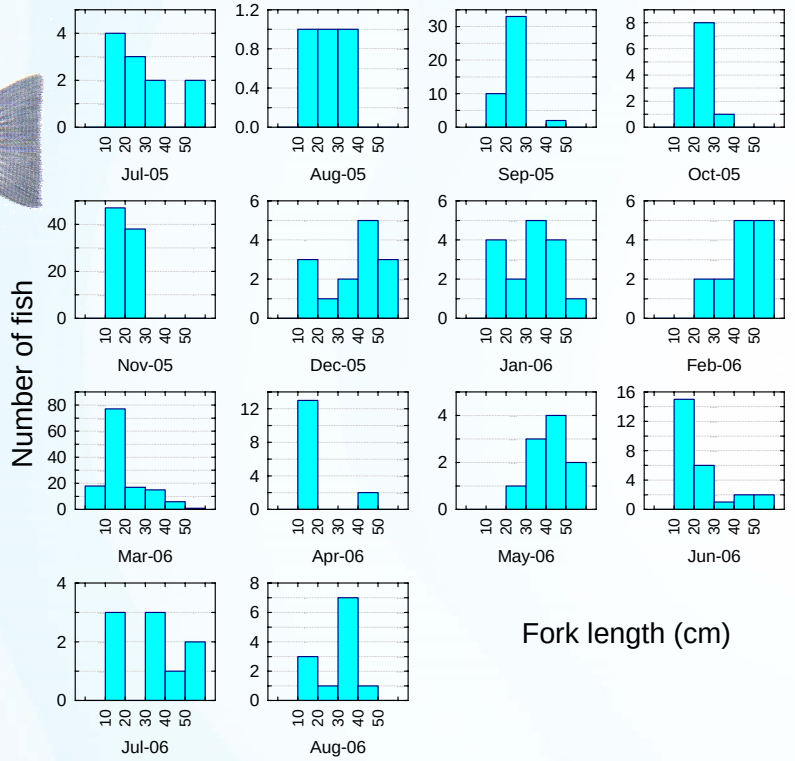
↙ Average number of mangrove jacks per table, number of tables per month and total number of individuals offered in Lae Main Market over the survey (n=125 tables).

↓ Sizes of fresh and smoked fish offered in Lae Main market (n=405).

Lutjanus argentimaculatus / Mangrove jack



Lutjanus argentimaculatus / Mangrove jack



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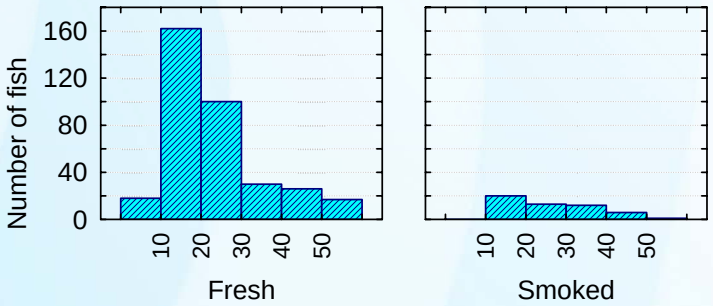
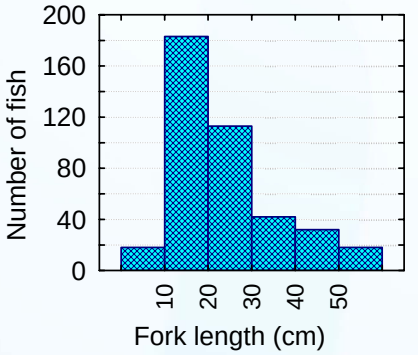


Lutjanus argentimaculatus / Mangrove jack



CRUSTACEANS

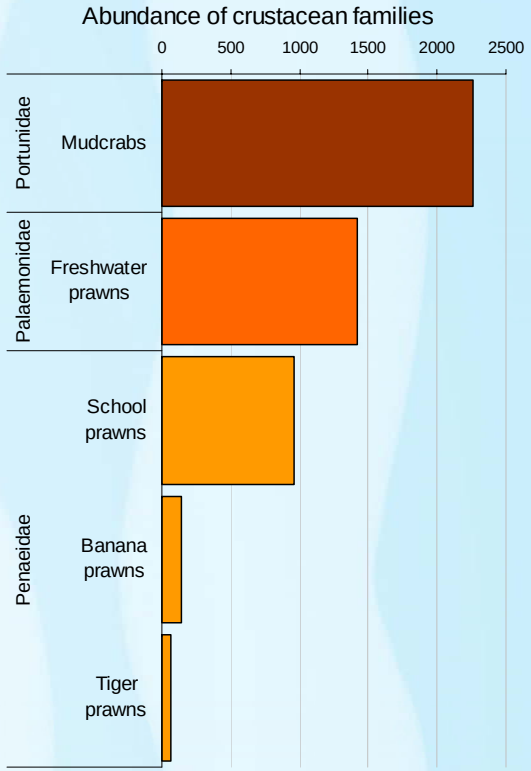
A total of 4,855 crustaceans, belonging to three families, were recorded and measured during the market survey. These included lobsters, and prawns of approximately five species.

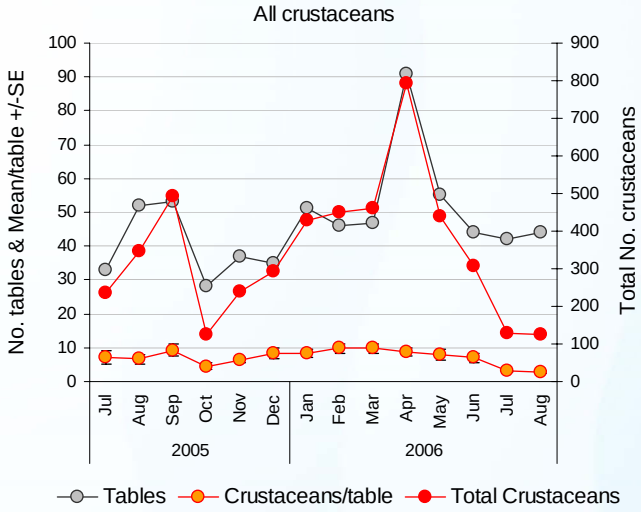
The average number of crustaceans for sale per table was 7.4 over the entire survey (range 1-62). Total numbers sold each month fluctuated significantly from a low of 125 in October 2005 to a high of 459 in April 2006. The large differences in numbers was mostly driven by changes in the number of tables selling crustaceans, rather than in the mean number per table.

The sizes of crustaceans for sale varied depending on the family and species, and the measure taken. Both tail length and carapace width were measured for all lobsters, prawns and crabs. The size ranges shown here include all crustaceans, with the peaks representing different families and species. A more detailed size analysis for lobsters, prawns and crabs follows.

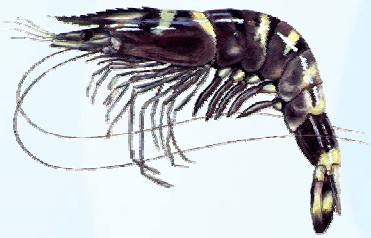
➔ Abundance of different groups of crustaceans recorded for sale during the survey (n=4,855).

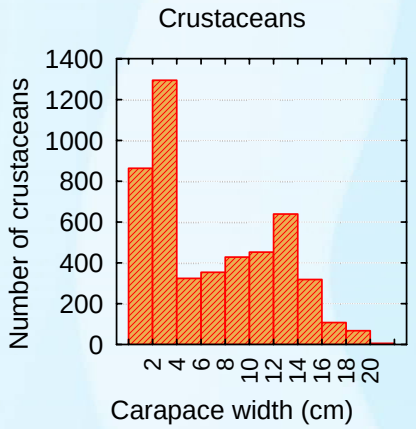
➔ Sizes of all crustaceans using carapace width and tail length (cm) recorded during the survey. These graphs give only a rough representation because very different groups have been combined to produce them. Detailed breakdowns are available on the following pages.

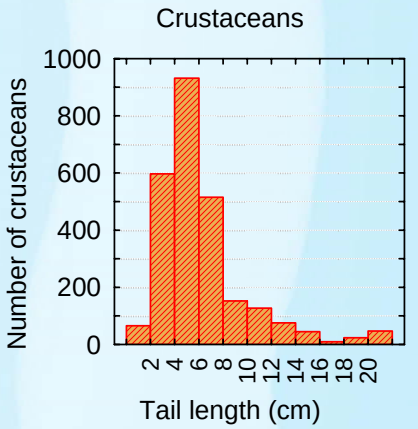




➔ Total number of all species of crustaceans per month, average number per table and number of tables offering them during the survey (n=287 tables).







MARKET

MARKET

CRUSTACEANS > Portunidae / Swimming crabs > *Scylla serrata* / Mudcrab

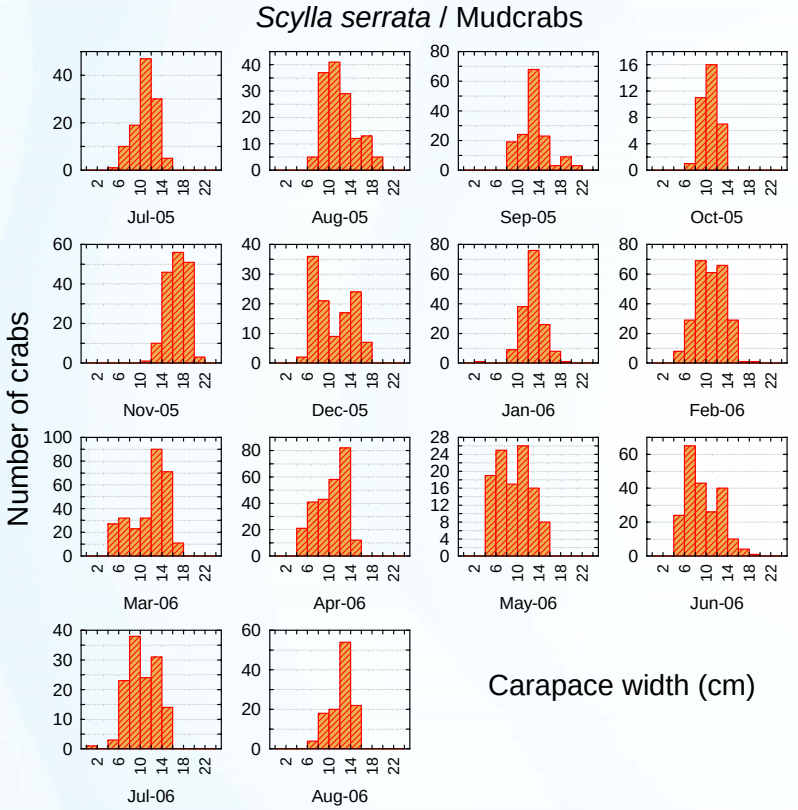
A large proportion of the crustaceans recorded for sale at Lae Main Market were mudcrabs (46%). A total of 2,263 mudcrabs were recorded in the markets, on a total of 503 tables. Mudcrabs were on offer on 60% of seafood tables and accounted for 18% of all seafood products for sale by count. The number of mudcrabs for sale fluctuated by month during the survey, with the greatest numbers being recorded during June 2006. Fluctuations in the available number were most related to the number of tables offering crabs per month, rather than differences in the number on offer per table.

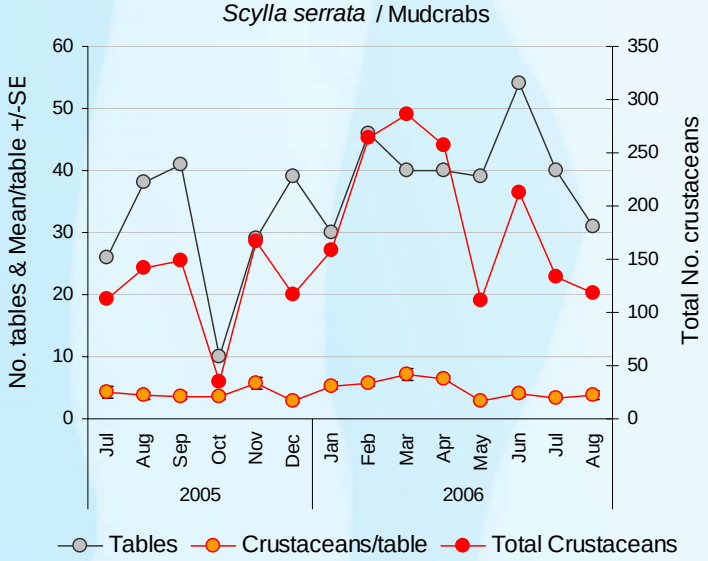
The average number of crabs per table was 4.5, but ranged up to 30. The average size of crabs was 12 cm across the body, ranging up to 22 cm. A slight majority of the crabs recorded at Lae Main Market were males, with a sex ratio of 46:54 female:male.

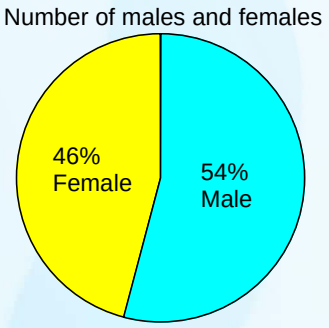
↘ Size distribution of mudcrabs in Lae Main Market during the survey, and broken down by sampling month (n=2,263 crabs measured).

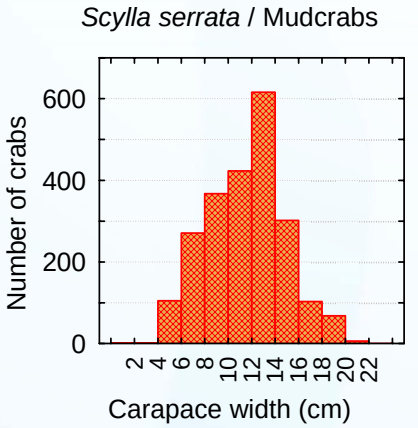
↙ Average number of mudcrabs per table, number of tables per month and total number of individuals offered in Lae Main Market over the survey (n=2,263 crabs and 503 tables).

↓ Sex ratio of mud crabs for sale at Lae Main Market.







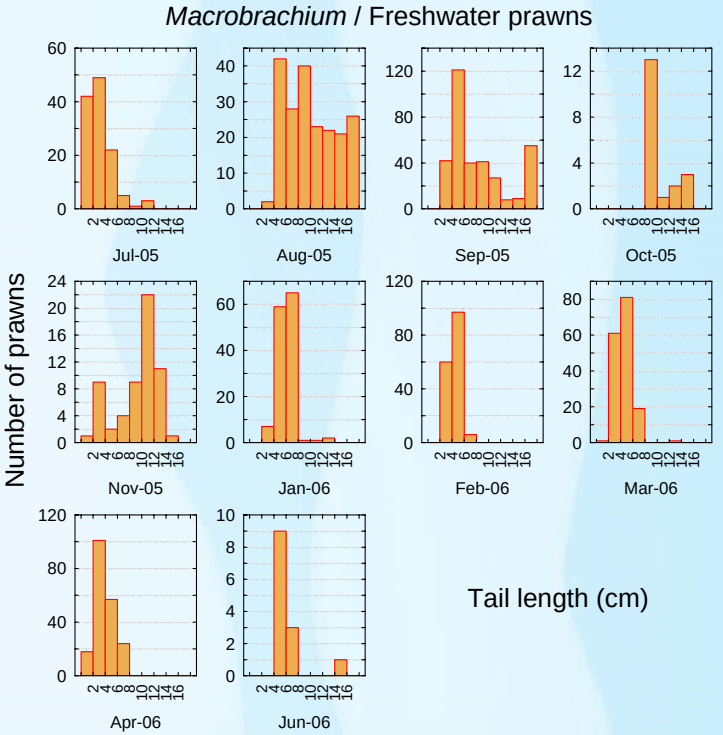


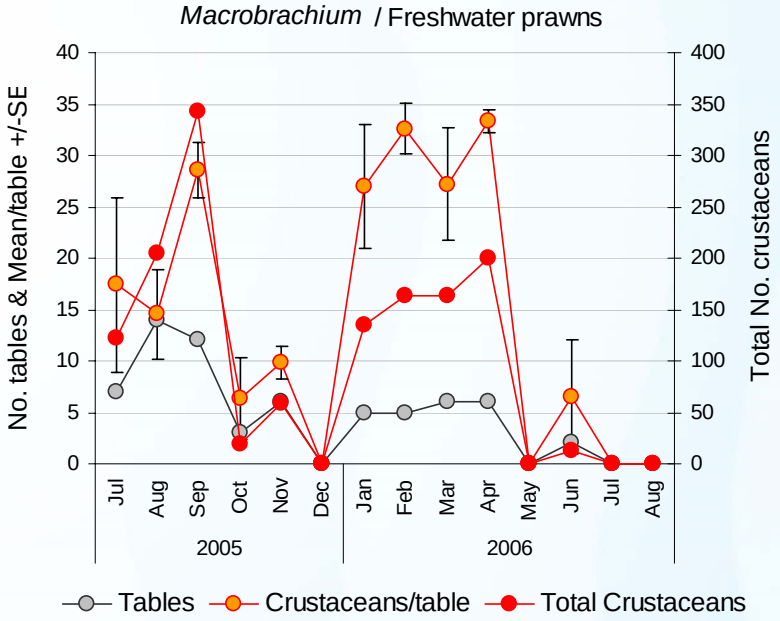
CRUSTACEANS > Palaemonidae > *Macrobrachium* sp. / Freshwater prawns

A total of 1,421 freshwater prawns were counted and measured at Lae market during the survey. They were present on 66 (8%) of all seafood tables and accounted for 11% of all seafood products recorded. The number of tables offering freshwater prawns varied during the survey and was highest in August-September 2005. Significant fluctuations in the total numbers offered per month were more related to the abundance of prawns on tables, rather than the number of tables. The overall average number of freshwater prawns per table was 21.5, and ranged between 1 and 62.

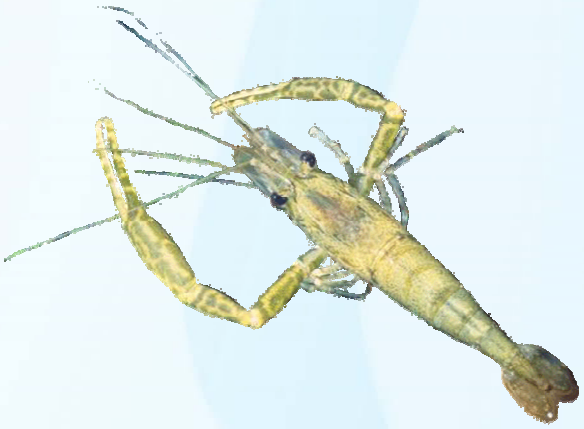
The average size of the prawns was 7 cm tail length and ranged up to 31 cm. There were significant differences in the sizes recorded in different months, with many small prawns present in July 2005, and after January 2006. The large numbers recorded in the period January-April 2006 may be related to an apparent reduction in the number of larger animals and an influx of young prawns at that time (see size graphs).

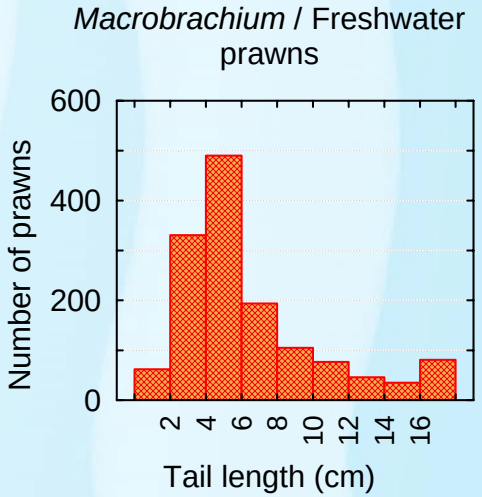
↘ Size distribution of freshwater prawns in Lae Main Market during the survey, and broken down by sampling month (n=1,421).





↙ Average number of freshwater prawns per table, number of tables per month of and total number of individuals offered in Lae Main Market over the survey (n=66 tables).





MARKET

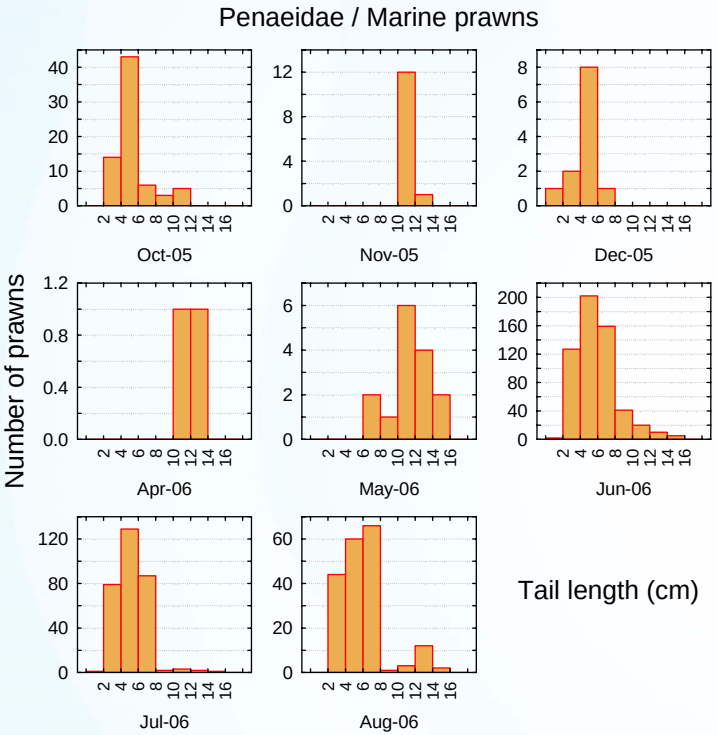
MARKET

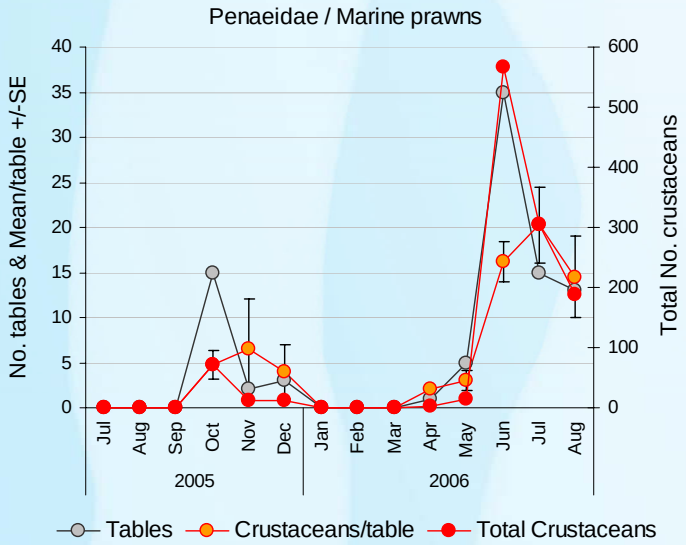
CRUSTACEANS > Penaeidae / Marine prawns

Over 1,171 marine prawns were recorded during the market survey. These were found on 89 tables, or 11% of all tables monitored. The number of tables offering these crustaceans varied during the survey, with many tables offering them in June 2006, and moderate numbers in October 2005. Marine prawns were absent from the market tables that were monitored for 6 of the 14 months. The total number of prawns was heavily influenced by the number of tables, but was also correlated with the average number of prawns offered at each table. The overall average number of prawns per table was 13 and ranged up to 40.

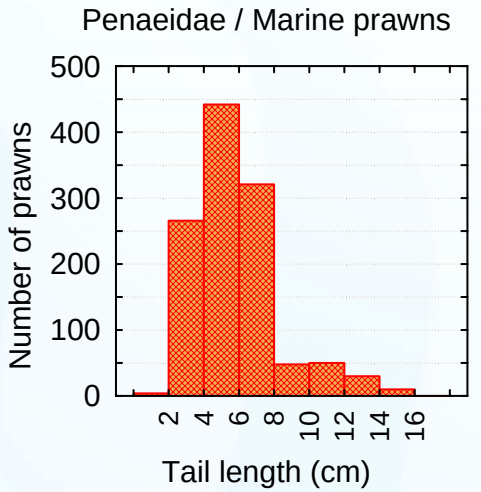
The overall average tail length for marine prawns sold in the market was 6 cm and their size range was up to 16 cm. Sizes changed significantly with month over the survey, with very few small prawns present in November 2005 and April-May 2006.

↘ Size distribution of prawns at Lae Main Market during the survey, and broken down by sampling month (n=1,171).





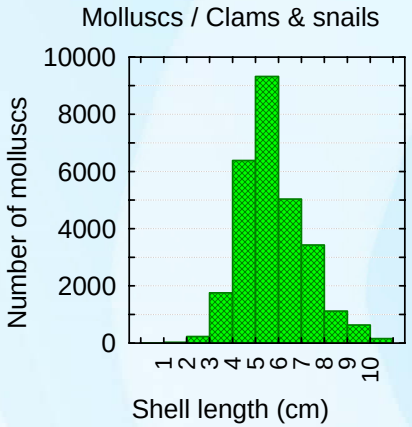
← Average number of prawns per table, number of tables per month and total number of individuals offered in Lae Main Market over the survey (n=89 tables).



MOLLUSCS

A total of 28,123 molluscs were recorded and measured during the market survey. These belonged to at least four families and species of clams, snails and squids. Molluscs were found on a total of 281 (33%) of seafood tables during the survey and accounted for 62% of all seafood products.

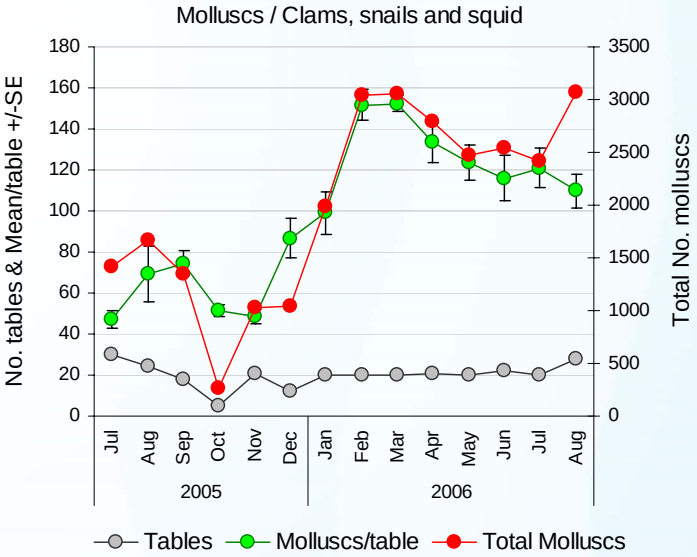
The average number of molluscs for sale per table, and total number for sale per month fluctuated over the survey, with greater numbers being recorded after January 2006. The average number recorded per table was 100 and ranged up to 219. Molluscs ranged in size between 2 cm and 13 cm shell length (excluding squid) with sizes being related to species (see next page).

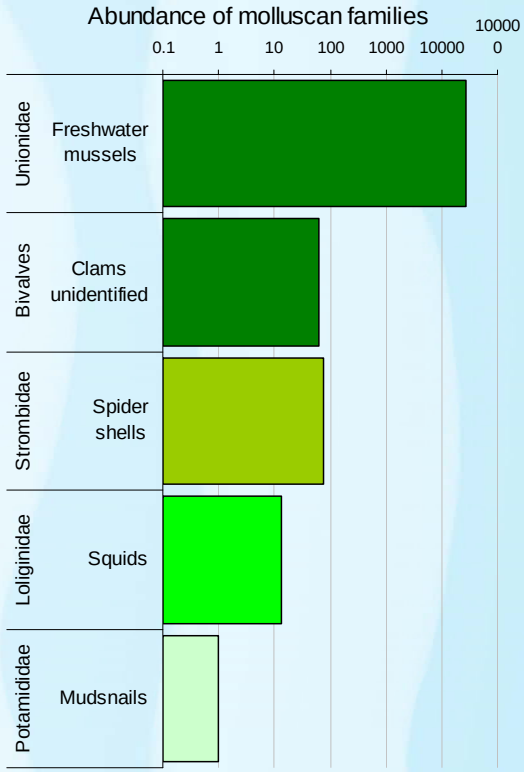


↑ Size distribution of molluscs recorded for sale during the survey across all months (n=28,123). Note that squids are excluded from this graph.

➔Relative abundance of all mollusc families and types.

← Average number of molluscs per table, number of tables per month of and total number of individuals offered in Lae Main Market over the survey (n=281 tables).





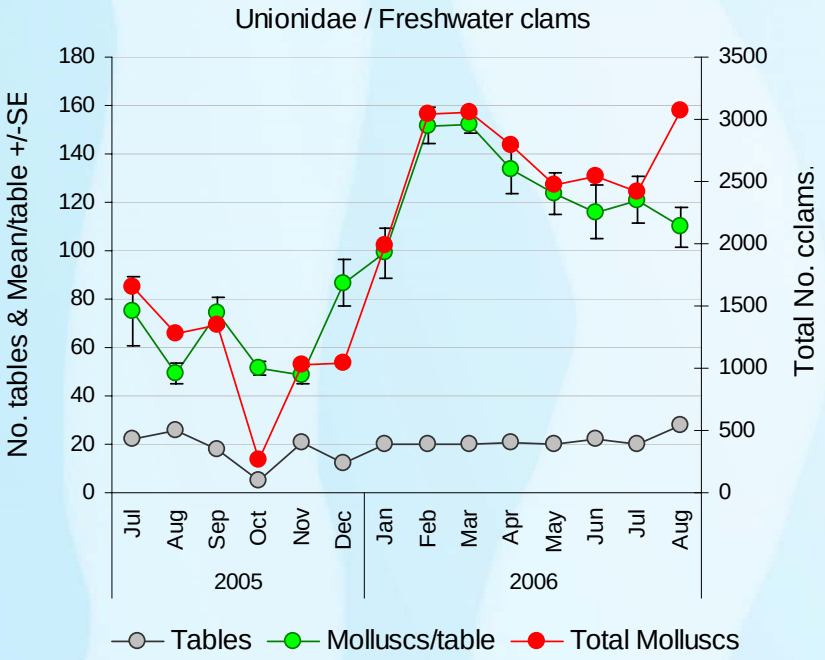
MARKET

MARKET

MOLLUSCS > Unionidae > Freshwater clams

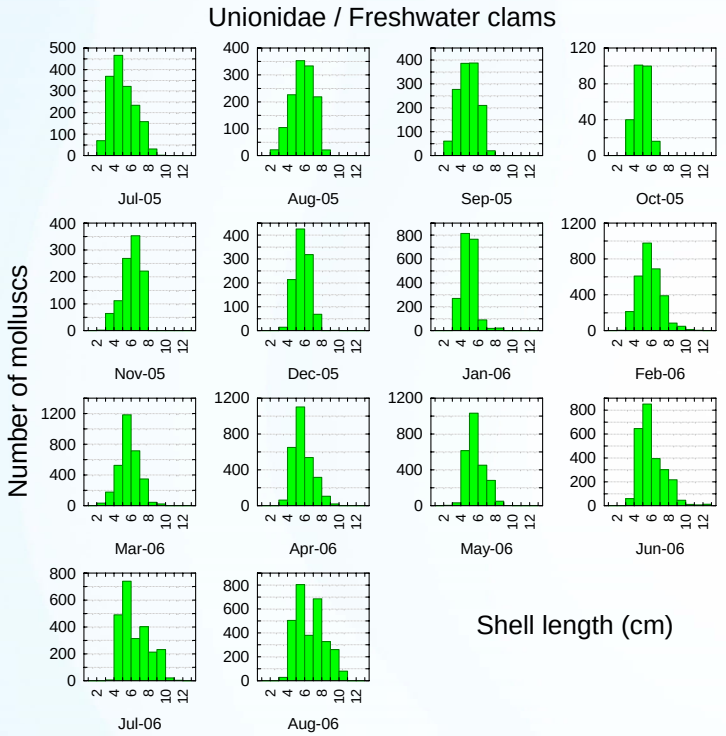
During the survey, 27,973 freshwater clams over a total of 275 tables were recorded. Numerically, these were the single most common species found at Lae Main market overall. The number of tables offering these molluscs was low and steady throughout the survey. Significant fluctuations in the number of clams offered for sale were mostly due to large differences in the average number offered for sale at each table. The overall average number of clams per table was 101.7, and ranged between 1 and 219.

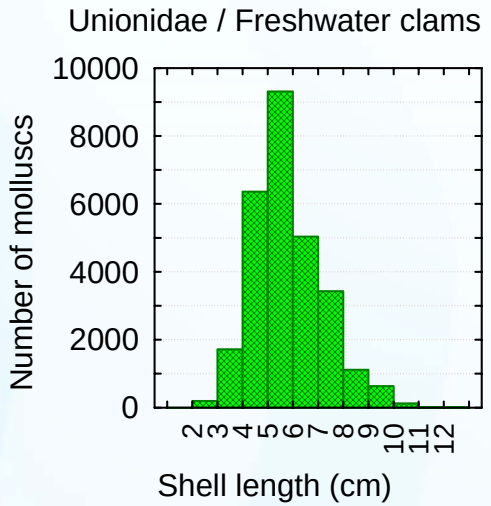
The average size of clams was 6.2 cm, ranging between 2 cm and 13 cm (measured as maximum shell length). Sizes varied by month with the largest clams offered for sale in February, June and August 2006.



↘ Size distribution of freshwater clams in Lae Main Market during the survey, and broken down by sampling month (n=27,973).

↙ Average number of freshwater clams per table, number of tables per month and total number of individuals offered in Lae Main Market over the survey (n=275 tables).





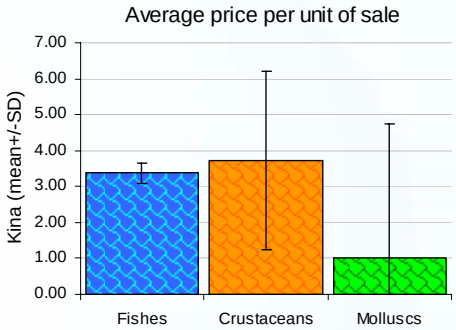
Prices and Income from Market Seafood Sales

Price information was collected for 2,494 seafood products on offer in Lae Market during this survey. Most of the seafood on sale were sold as individual animals (whole single fish or crabs) with a price per item quoted. Molluscs and prawns tended to be sold in baskets, heaps or boxes with a price quoted referring to about 100 animals forming a single unit of sale.

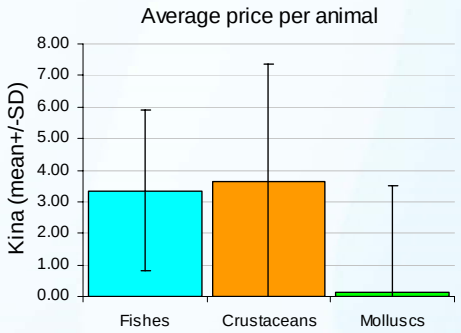
The average price of seafood products was higher for several groups of fish than any of the crustaceans or molluscs. The most valuable seafood was a gudgeon, but this was based on only one individual fish. Taking into account the number on a table and the price per unit of sale, the greatest income per day was derived from tunas and mackerels, followed by fusiliers and tilapias. These would be considered the seafood products that contributed the most to the daily income of sellers at average availability. Mud snails, and a range of smaller estuarine fish, tended to contribute the least income per day to sellers. On a per unit of sale or price per animal basis, the most valuable seafood group was crustaceans, which sold for K3.73 per animal.

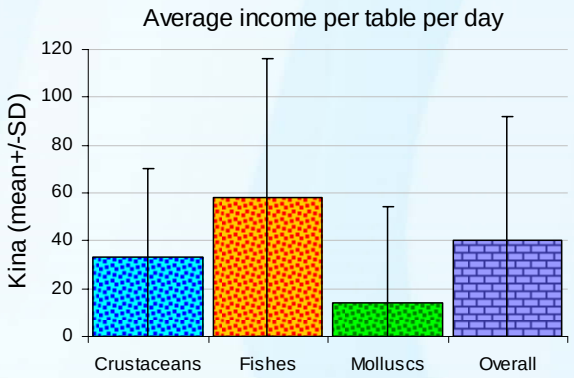
➔ Average income per day derived from different families of marine products. Values are average total income that would be derived through each group based on average prices and numbers normally offered per table. These figures are potentials and would depend on all the products on offer being sold. People selling fishes, normally offer more than one group / species per day, so values do not reflect incomes across a whole table (but see Figure below-left) (n=3,233).

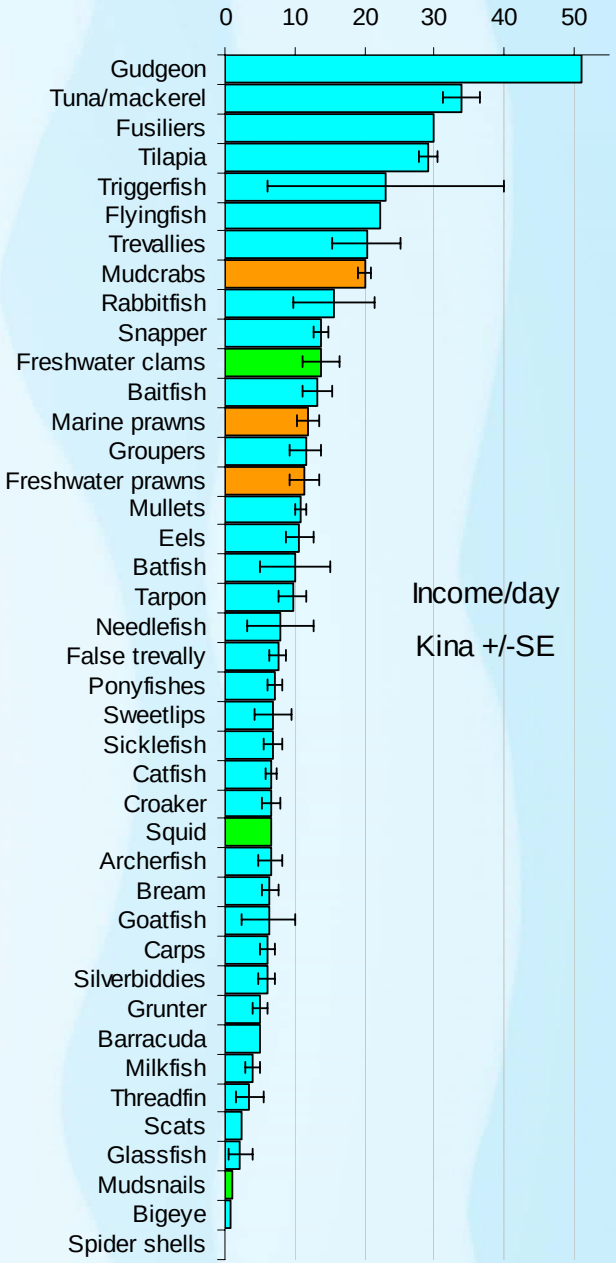
	Unit of sale	Number/unit	Min	Max
Fishes	Whole	1		
Crustaceans	Whole	1		
	Heap	30.9	10	62
Molluscs	Heap	99.4	1	219
	Basket	99.1	1	163
	Box	78.3	50	106



↑➔ Average price per units of sale, per animal and average income per table per day for the major groups of seafood products offered in Lae Market. These figures are potentials and would depend on the products on offer being sold (n=2,494).

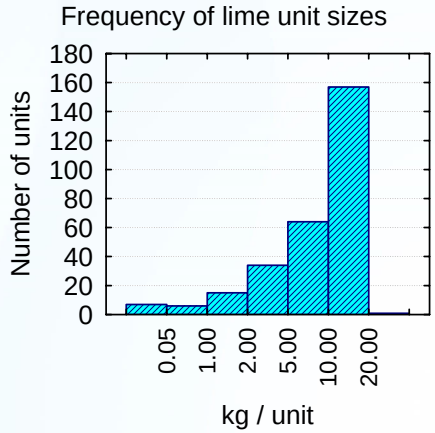




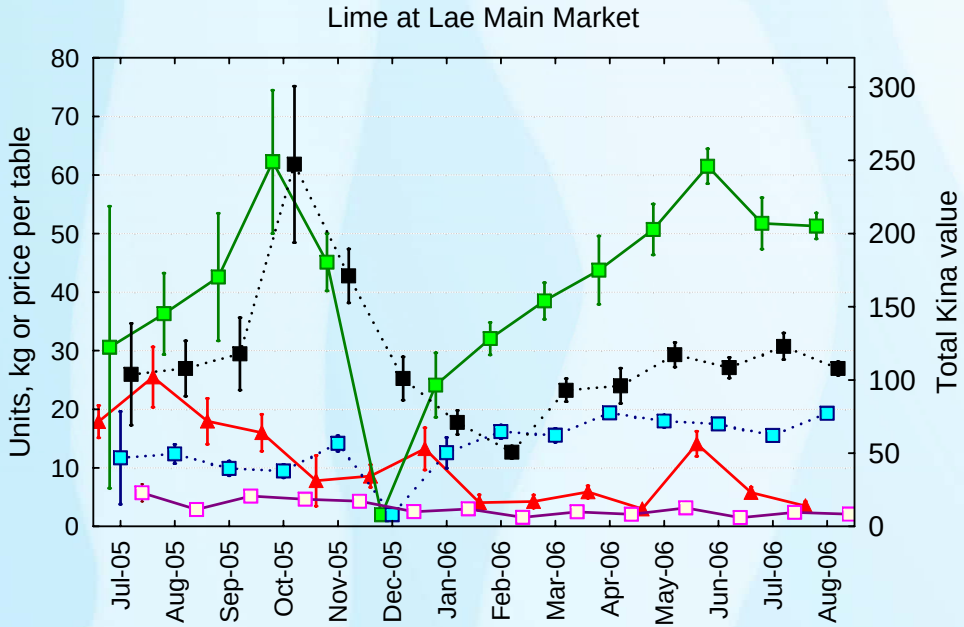


LIME

Lime produced from the shells of freshwater mussels and used for betelnut chewing was available at Lae Main Market all year around. Over the survey, information was collected from 532 tables on which lime was being offered for sale. The lime was packaged in a range of sizes, from small plastic bags holding around 50 g through to large sacks of up to 50 kg, with sellers often offering several sizes on a single table. The containers used included plastic bags, film containers, jars and brown paper. Because lime is far less perishable than seafood, the information that follows is given on a per table per day basis, and it should be understood that any unsold lime can be offered on many days. These results cannot therefore be added to determine total revenue from lime sales.



↑ Size of packets, bags and jars of lime for sale over the survey (n=532 tables).



The average number of units (bags, jars or containers) of lime for sale per table per day was about 8 and ranged between 1 and 45. The average total weight of lime for sale on tables was about 34 kg, ranging between 250 g and 160 kg. On any one day, the total kina value of lime on sale averaged about K62, with a maximum recorded value of K810 if all of the stock were sold on that day. The average value of the lime ranged between K1 and K22.50, depending on the size of units being used, with bulk lime generally (but not always) being cheaper to buy than small quantities for immediate use. The most commonly offered units of sale were 20 kg bags, but this may be related to differences in turnover rather than absolute differences between unit sizes. There were significant fluctuations in the stock of lime available over the survey, with very little in stock during December 2005, and peaks during October 2005 and June 2006.

← Summary of lime sales at Lae Main Market between July 2005 and August 2006.

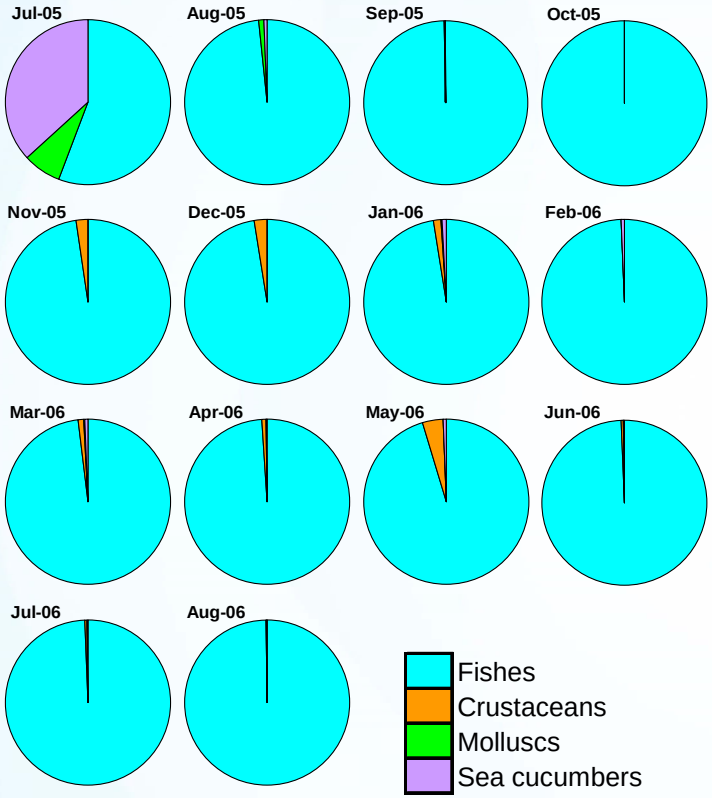
- Total units of lime for sale per table (left axis)
- Total kg of lime for sale per table
- Average kg per unit of sale
- Average price per kg
- Total Kina value per table (right axis)

Marine Products Sold to Buyers

WHICH SEAFOOD PRODUCTS ARE BEING PURCHASED?

Buyer data were collected over the period from July 2005 to August 2006. The data included fresh and dried marine products of four major groups: fishes, crustaceans, molluscs and sea cucumbers. Overall, 99% of all of seafood brought in by weight were fishes (including fresh fish and dried shark fin), with only minor quantities of crustaceans and sea cucumbers (1%). A total of 829 transactions were recorded and 81,752 seafood products counted and measured during the survey. These results can be taken as characterising the types of seafood brought to buyers, the average prices, sizes and quality of the marine products, and incomes for fishers. These figures are not sufficient for calculating the volumes of products going through the buyers because they are discontinuous, and it was not possible to obtain good estimates of buyer intakes (or to obtain such data from them). Our buyer database includes data from eight buyers, five of whom focus on fresh seafood, and three on dried products.

A total of 177.7 tonnes of purchased seafood were recorded during the periods covered by these data. On average, fishers brought around 10 items to buyers on each transaction. The minimum number of seafood products brought was 1 and ranged up to 487 items (2.6 tonnes). Most transactions were for a single type of seafood product, but there were small numbers of transactions with people who brought in combinations of two to three different groups of animals. Most transactions concerned fresh fishes with some shark fins.



➔ Breakdown of seafood products purchased by buyers by group and province over the survey. Data are total weight purchased over the period of the survey (n=81,752 records).

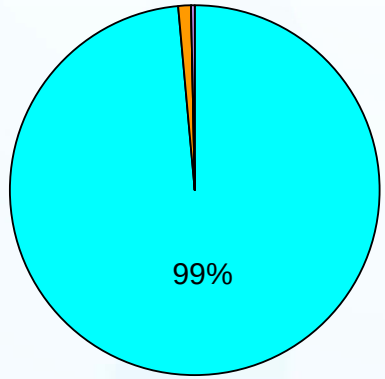
BUYER

Buyer	Group	Product	Mean number	Total number
Andersons Foodland	Fishes	Fresh	5	158
Frabelle	Fishes	Fresh	17	5,039
Papindo Trading	Fishes	Fresh	7	49,903
	Crustaceans	Fresh	9	548
Lae Main Market	Fishes	Fresh	6	255
	Crustaceans	Fresh	8	25
Maps Tuna	Fishes	Fresh	9	6,321
	Crustaceans	Fresh	4	21
Asia Pac Ltd (Lae)	Sea cucumbers	Dried	38	10,715
	Molluscs	Dried	150	6,303
	Fishes	Dried	10	800
Patanmar Marine Products	Sea cucumbers	Dried	45	1,266
Buka Enterprise	Sea cucumbers	Dried	80	398
Totals			10	81,752

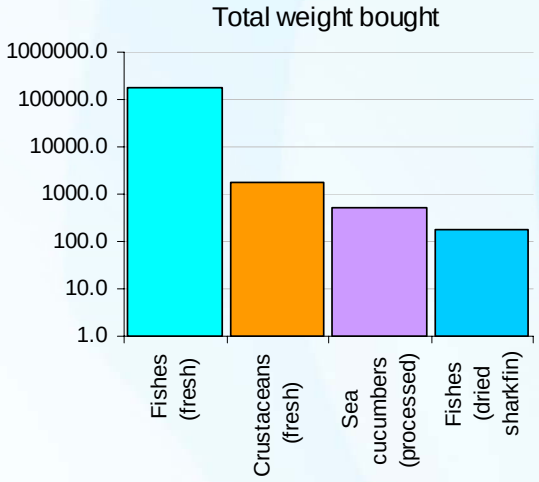
←→ Average number of seafood products per transaction and total numbers of seafood products measured for all buyers and groups sampled during this survey. The second half of this table ➔ shows numbers of combined transactions. That is, transactions involving several types of seafoods.

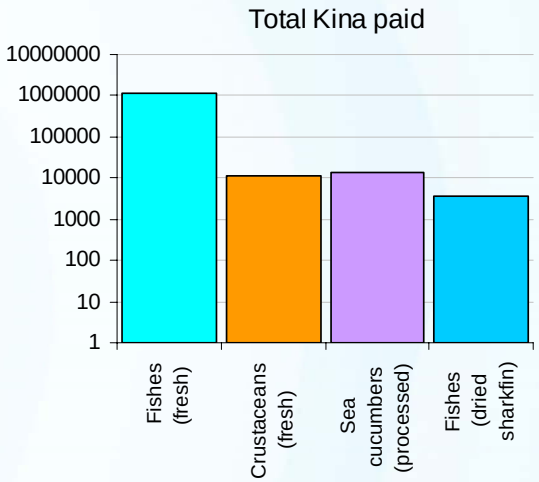
Group			Transactions	Total numbers
Fishes			690	62,476
Crustaceans			4	594
Molluscs			23	6,303
Sea cucumbers			58	12,379
F+	C		37	
F+	M		5	
F+	S		2	
S+	M		8	
F+	M+	S	1	
C+	M+	S	1	
Total			829	81,752

Types of seafoods



In terms of weight, sellers brought an average of 12 kilograms of marine products to buyers per transaction. Fishes were the most important product by weight, totalling 175.2 tonnes. The total amount of crustaceans sold to buyers was just under 1.8 tonnes. Sea cucumbers amounted to 510 kg dry weight, which would have amounted to 10 times that amount as fresh weight. Sharkfins accounted for 0.1% of the products sold to buyers amounting to 180 kg during the survey. The most income overall was provided by fresh fishes. Overall with more than 1.13 million kina were paid out by buyers over the survey period just for the seafood we intercepted. The real amount would have been far higher than this as our values are only the totals from a subsample of the seafood products being sold to buyers. Of this amount crustaceans and sea cucumbers contributed around K11,000-13,000 each, and sharkfins about K3,600.



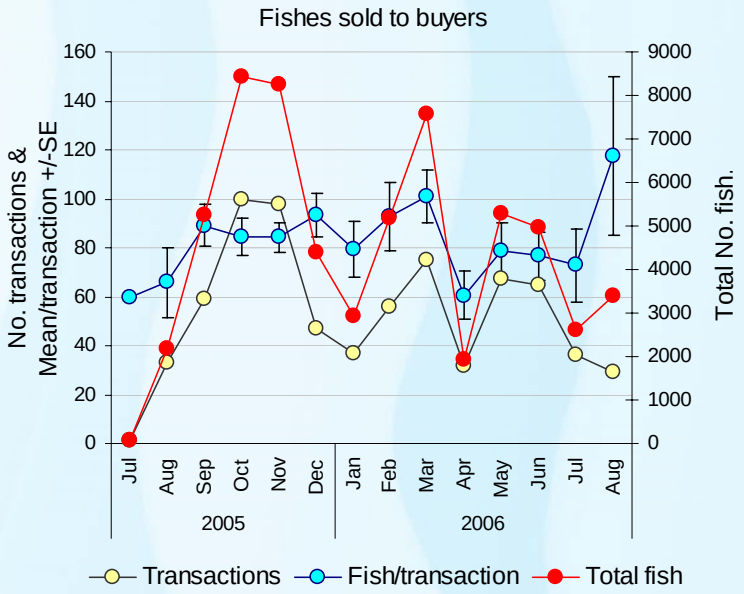


↑ Breakdown of seafoods purchased by buyers over the survey period. The record-keeping is too poor to allow for detailed analysis, with the fish and crustacean weights being estimated

Fishes

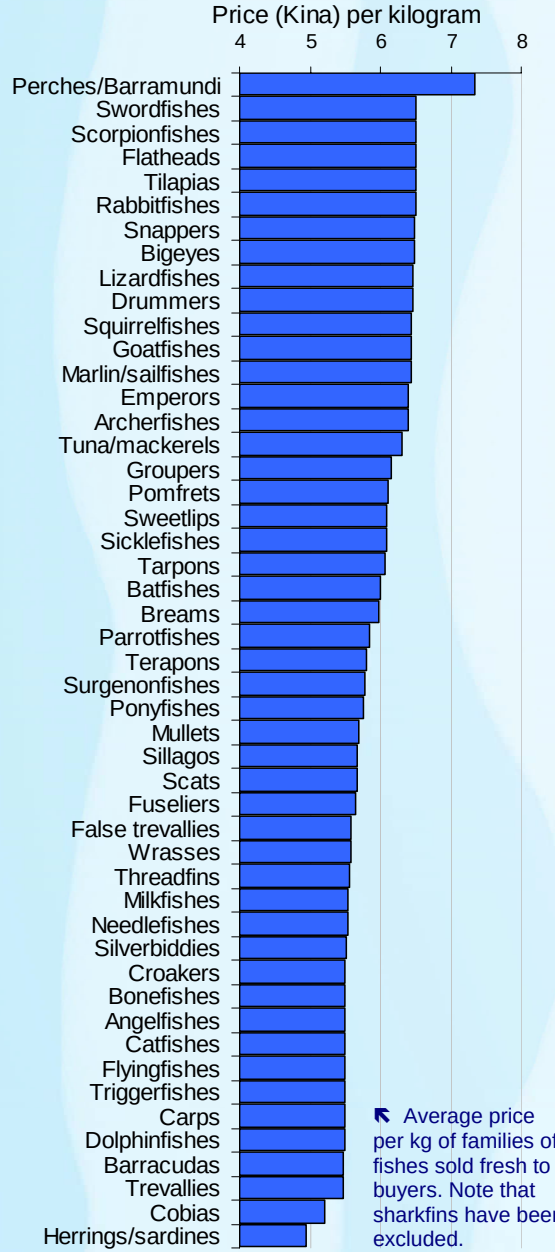
Fishes from 50 families and 288 species were recorded during the buyer survey between July 2005 and May 2006. This included nearly 175.3 tonnes of fish (62,476 individuals) normally found in rivers, lakes, estuaries, reefs and offshore areas (pelagic species). The largest fishes sold to buyers were marlins and sailfish, dolphinfish and cobias. The largest fish recorded was 339 cm long, a blue marlin caught in November 2005. The most valuable fishes sold to buyers were sharks (fins) at K55.60 kina/kg. Barramundi were the most valuable fresh fish, and were on average purchased by buyers at K7.35/kg. The overall average price per kilogram for fresh fishes was K6.10 / kg, and the least expensive fishes were herrings and sardines.

Most of the fishes sold to buyers were caught on reefs, offshore, or from around offshore fish aggregating devices (FADs = 17%). Although present in great numbers in the market, river and estuarine fish formed only a small component of those sold to buyers by either weight or total numbers (count).



← Average number of transactions, mean numbers of fish per transaction and total numbers of fishes recorded sold to buyers during the survey.

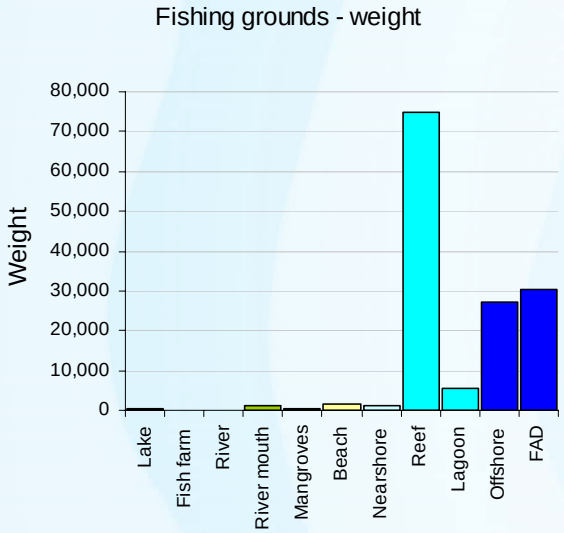
BUYER

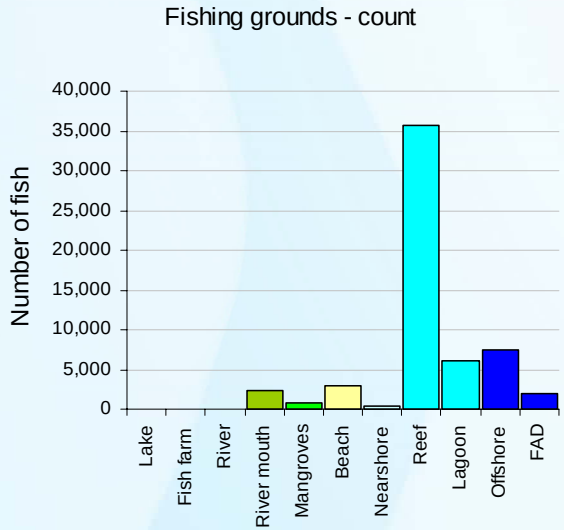


↖ Average price per kg of families of fishes sold fresh to buyers. Note that sharkfins have been excluded.

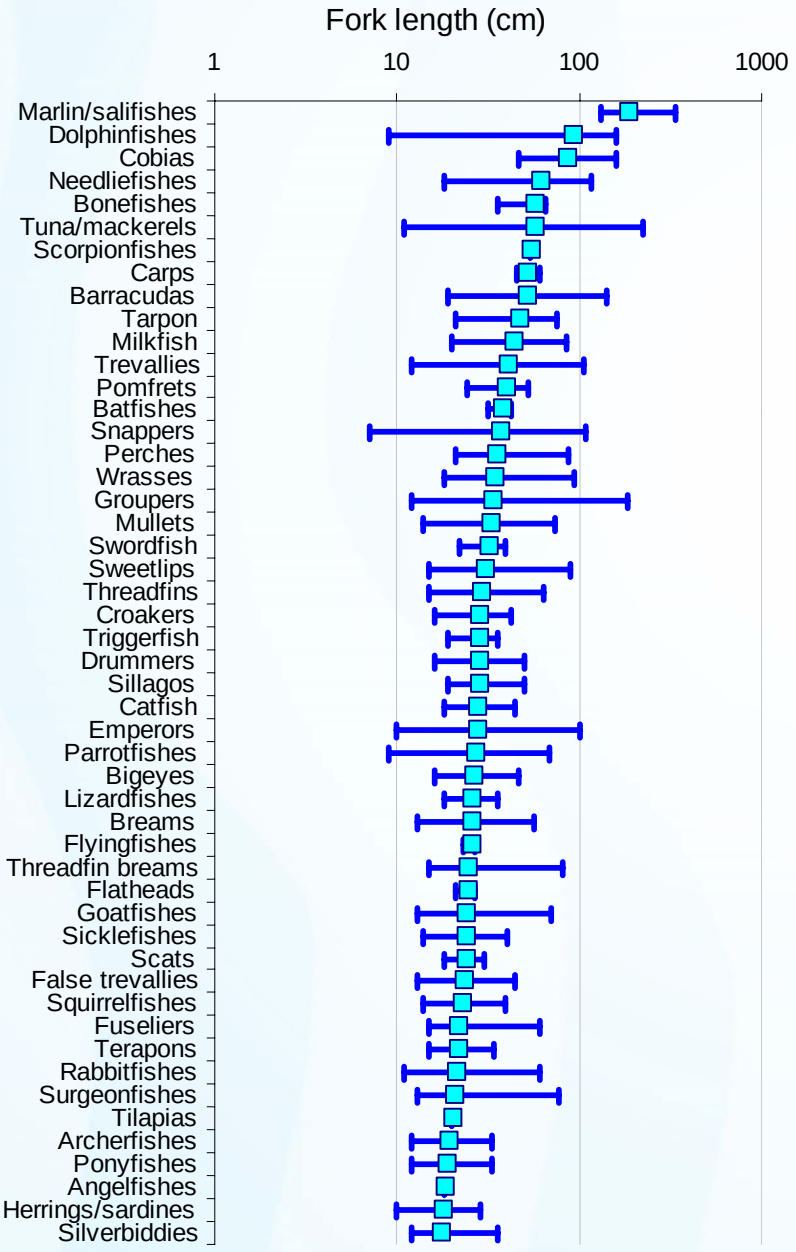
BUYER

↓ Total catches of fishes by weight and count from different types of fishing grounds (n=.61,676 fish).



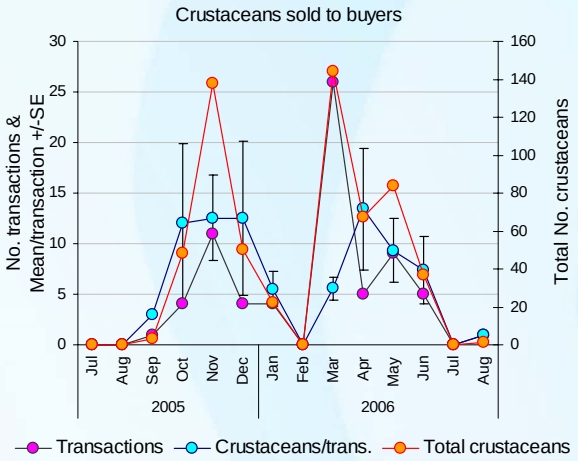


➔ Average, minimum and maximum sizes of fishes sold to buyers, organised by families (n=.62,476).

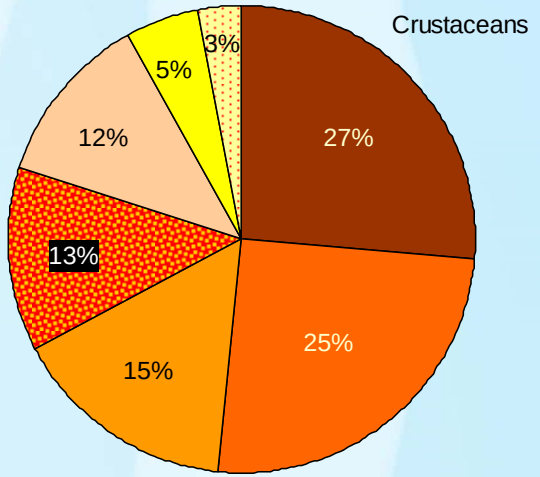


Crustaceans

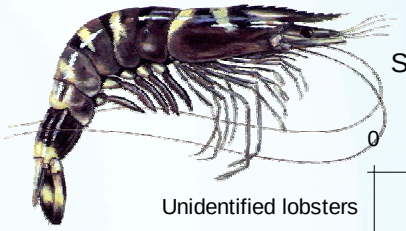
A total of 594 crustaceans was recorded in the buyer survey between September 2005 and August 2006. They were recorded in over 70 transactions with an average of 8.4 crustaceans sold per transaction (and a maximum of 37 in a single transaction). Using estimates of weight calculated from tail lengths, we recorded about 100 kg of crustaceans overall. Most of the crustaceans purchased (by number, not weight) were lobsters (80%) and marine prawns (the remaining 20%). The mud crabs and freshwater prawns common in the market surveys were absent from buyer samples.



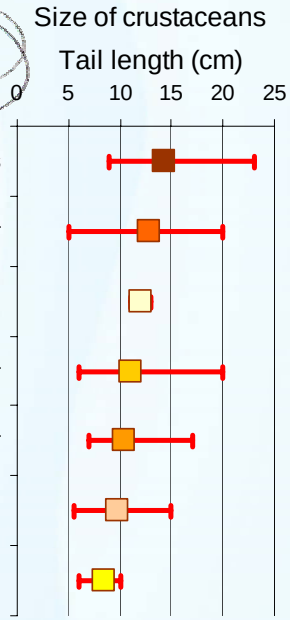
↑ Number of transactions, average number of crustaceans sold to buyers per transaction and total crustaceans recorded sold per month of the survey (n=70 transactions).



Purchases of crustaceans fluctuated through time, with peaks during November 2005 and March 2006. The months with no crustaceans (July-August 2005, February 2006, and July 2006) were ones in which surveyors were unable to intercept any samples with crustaceans at buyer premises, so probably represent real periods of low supply.

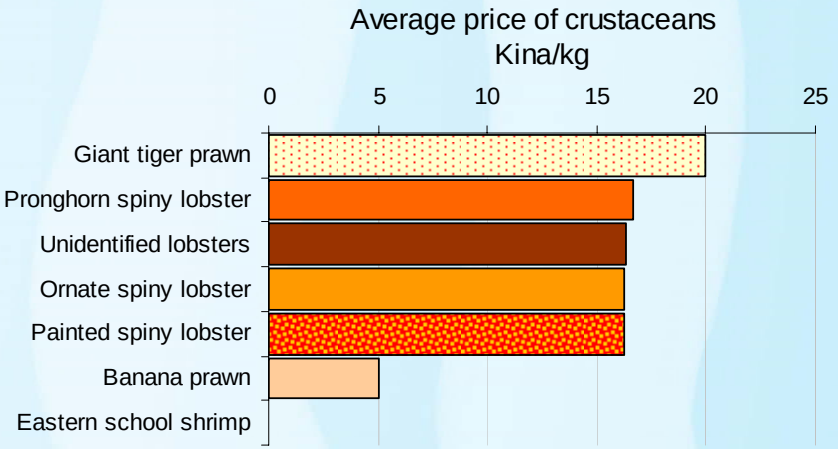


The most valuable species of crustaceans were tiger prawns, which fetched an average of K20/kg during the survey period. All species of lobsters were usually sold at around K16-17/kg. Banana prawns were the least valuable, selling for about K5/kg.



➔ Average and maximum and minimum sizes of crustaceans sold to buyers.

↗ Relative proportion of different species of crustaceans sold to buyers based on counts. (n=594 crustaceans). ↓ Average price paid by buyers for different species of crustaceans. Note that values are based on proxy weights. For prawns weight = 0.005*length^3.162 and lobsters =0.00003671*tail length^3.00056.



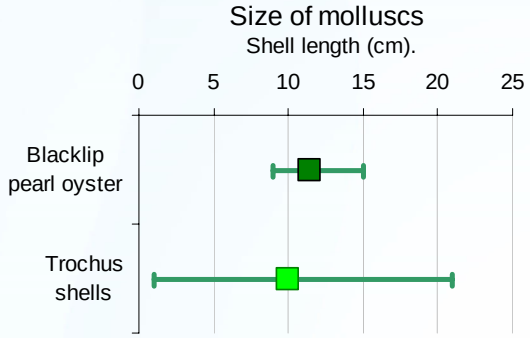
BUYER

MOLLUSCS

Only two types of molluscs were purchased by buyers during this survey: trochus shells and pearl oysters. The total number of molluscs purchased over the period covered by these data was 6,303 animals recorded over 42 sales, amounting to 181 kg. Most of these were trochus shells at 99% of all molluscs by number (6,219 animals). Only 84 black-lipped pearl oysters were recorded during the survey.

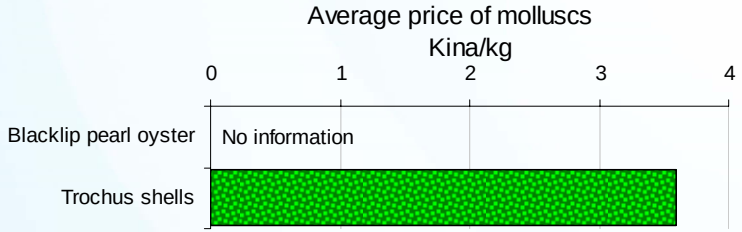
The average total purchase of molluscs was around 450 animals per month, and ranged as high as 487 molluscs in August 2005. The average load size brought in by people to the buyers was around 4.88 kg/person/day. The maximum weight of molluscs brought by people brought to a buyer over the survey was 28 kg.

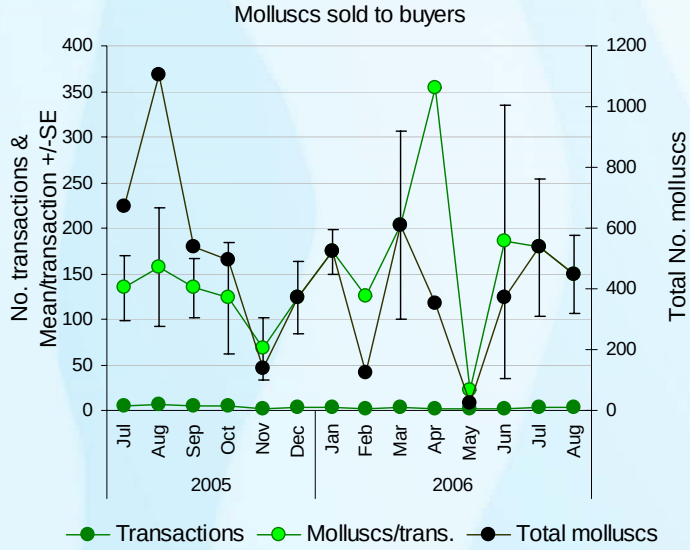
The price paid for trochus shells averaged K3.60/kg. No estimate was available for black-lipped pearl oysters.

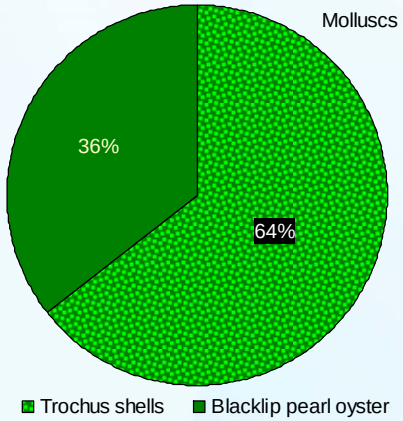


↑ Mean size of loads of molluscs brought by individuals to buyers during each month of the survey.

↓ Average price for molluscs paid by buyers during the survey.







BUYER

➔ Breakdown of molluscs by weight and percentage purchased by buyers over the survey period.

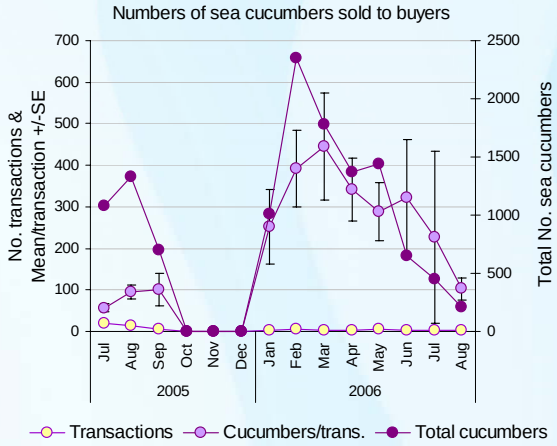
Sea cucumbers

A total of 510 kg of sea cucumbers (dry weight) were recorded over the period from July 2005 to August 2006. This included a total of 12,379 individuals sold to buyers in 69 transactions. Sea cucumber purchases included at least 20 species from 2 families and 6 genera, as well as some unidentified forms. Amounts purchased per month varied significantly as a result of closed seasons. Peak numbers and weights were recorded in February 2006, with numbers, weight and transactions per month declining in the months following. Only a small number of transactions per month (between 1 and 19) were observed.

The most common species recorded (by number) was surf redfish (1,580 animals), with the next most common species being tigerfish, stonefish and lollyfish. The most valuable sea cucumbers were sandfish, Grade A (best quality) for which sellers were paid an average of K95/kg. At least one-third of all species/grade combinations recorded were valued at less than K10/kg.

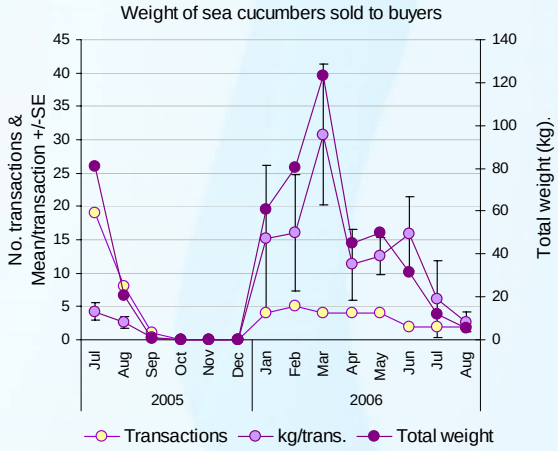
Family	Scientific name	Common name	No.
Holothuriidae	*Actinopyga mauritiana*	Surf redfish	1,580
	Bohadschia argus	Tigerfish/Leopardfish	1,207
	Actinopyga lecanora	Stonefish	1,084
	Holothuria atra	Lollyfish	1,240
	Actinopyga miliaris	Hairy blackfish	288
	Holothuria fuscogilva	White teatfish	819
	Holothuria nobilis	Black teatfish	378
	Holothuria coluber	Snake fish	894
	Bohadschia similis	Brownspotted sandfish	665
	Pearsonothuria graeffei	Flowerfish	524
	Holothuria fuscopunctata	Elephant trunkfish	147
	Holothuria edulis	Pinkfish	68
	Holothuria scabra	Sand fish	46
	Bohadschia vitiensis	Brown sandfish	42
Stichopodidae	*Stichopus hermanni*	Curryfish	1,538
	Thelenota ananas	Prickly redfish	954
	Thelenota anax	Amber fish	470
	Stichopus chloronotus	Greenfish	302
	Stichopus horrens	Dragonfish	108
Total			12,379

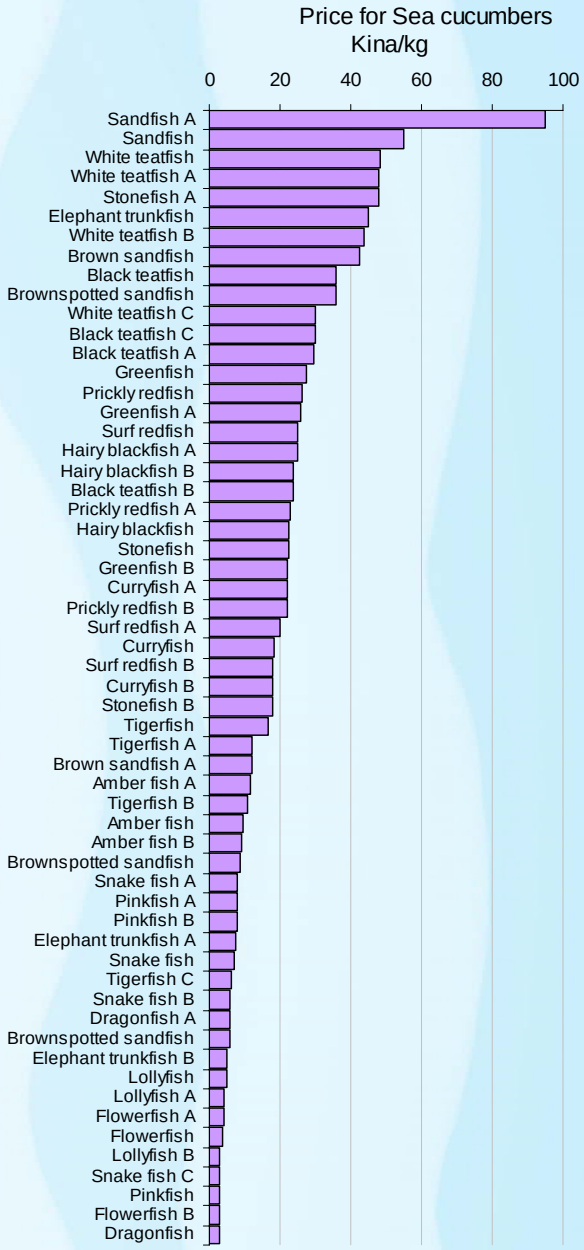
↘ Average price paid per kilogram for species of sea cucumbers.



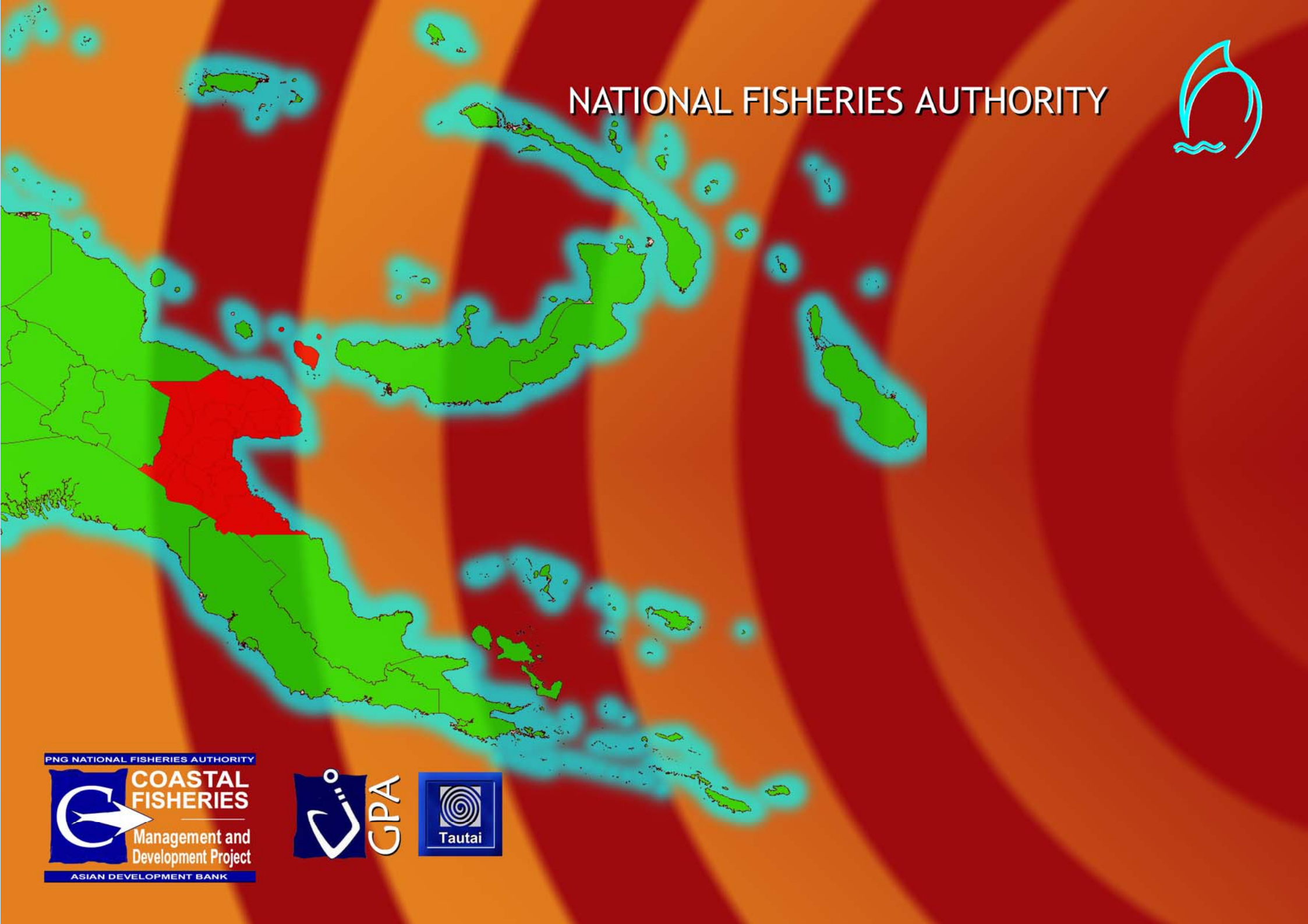
↑↓ Number of transactions, sea cucumbers per transaction, and total numbers and weight of sea cucumbers sold to buyers per month (n=12,379).

↙ Numbers of sea cucumbers purchased by species.





BUYER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